MASTER'S THESIS

A critical analysis of the sustainability performance in the retail food service outlet sector of South East Queensland.

Grigalius, Simon

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A critical analysis of the sustainability performance in the retail food service outlet sector of South East Queensland.

Simon Grigalius
#13216722

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Abstract

During two decades as a hospitality professional the researcher witnessed first-hand a growing breakdown in the management of waste streams and resources in the hospitality industry, and in particular the retail food service outlets (RFSO) sector, both locally in South East Queensland and multiple locations around the globe. Observations of the excess resources consumed by these operations compelled the researcher to investigate the sustainability of the current food system, and any influences the RFSO may be having on it, with the intention of developing a sustainability performance program aimed at improving environmental awareness and management of resources in this sector.

The following topics were researched to assist in the hypothesis; *Can a sector specific sustainability performance program influence the resource consumption of retail food service outlets?*

1. What indicators define the current food system and is the current agri-industrial system sustainable?
2. RFSOs and their importance when identifying sustainability of the current food system,
3. What are the current approaches to manage sustainability in the RFSO sector.

A waste trial and sustainability performance program was then developed to test this hypothesis, however the waste trial (Part 1) was abandoned due to failure to recruit suitable representation from the sector.
Scrutinizing the lack of up-take to the waste trial by sector representatives it became evident there was a disparity on the importance of environmental sustainability specific to the RFSO sector and in particular its sustainability performance and how it is measured.

Part 2 of the study was then developed for the operational staff in the RFSOs to enable: a *critical overview of the sustainability performance of the local RFSO sector.* This required the identification of sustainability performance key criteria specific to the RFSOs operations and consisted of:

- Sustainability education and training,

- Sustainability knowledge and awareness,
- Sustainability behaviour, and
- Sustainability management.

A sustainability performance audit was also developed to assist in identifying the sustainability performance of each venue represented by the participating RFSOs due to the research highlighting no commonly recognised tools for measuring sustainability performance.

Although this research is only exploratory in nature, initial results identify a common theme of resource over-use, poor comprehension of the sectors sustainability and how it is managed in the participating RFSOs.

Declaration

This thesis is submitted to Bond University in fulfilment of the requirements of the degree of Masters by Research.

This thesis represents my own original work towards this research degree and contains no material that has previously been submitted for a degree or diploma at this University or any other institution, except where due acknowledgement is made.

Acknowledgements

I'm grateful to be so lucky, to be among the privileged few to have the opportunity to broaden their mind through education.

I would like to acknowledge my supervisor Prof Daryl McPhee; his patience and belief in my ability, his skilled guidance in diction and encouragement for me to focus on the important things have made this thesis possible.

I would also like to acknowledge; Dr Greg Miller, for his guidance, expert knowledge and for constantly pushing me out of my comfort zone, Prof Tor Hundloe for his encouragement, expert wisdom and deft reasoning, Dr Grant & Dr Kristy Fraser-Kirk, their achievements inspirational and their friendship holds me accountable.
I'm grateful for the numerous other influences who've supported and influenced me in my quest to contribute to a fairer food system; my family and friends and the industry change-makers standing for ethics and environment over profits.

Most importantly I'd like to acknowledge my wife Raquel Dos Santos for her amazing support on this journey of juxtapositions; calm and chaos, failure and success, gloom and confidence. Her wisdom and compassion inspirational, her will and focus motivational, I am humbled by her virtues.

Conceptual diagram of thesis

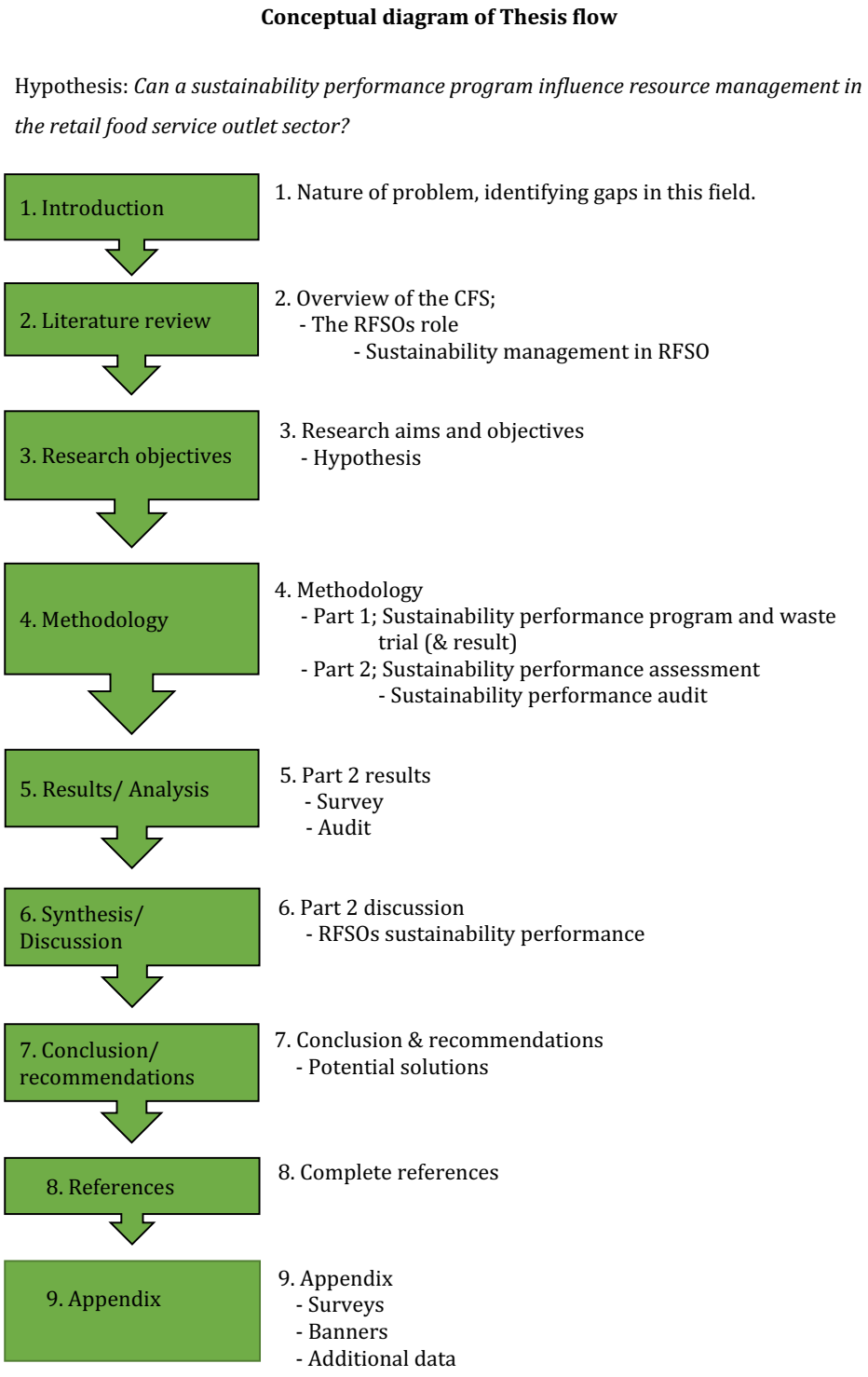

Figure 1. Conceptual diagram of thesis

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1. Introduction

Food is essential for the survival of the human race, and what we eat and how we produce it is arguably one of the greatest concerns facing the future of humanity. As the global population continues on its projected growth the issue of food security and the sustainability of food production systems is increasing in importance. Food production systems have shown a high reliance on finite resources, and as such different approaches are needed to meet the future demand for food from the growing global population.

Although the growth in global population of recent times can also be credited to medical advancements, the past, present and future of the human race is inextricably linked to various breakthroughs in food production (Evans, 2001).
The population growth and the main reasons for this include:

- One billion, 1500-1825: Land clearing, using animals to plough cleared fields and introduction of foreign foods (plants and animals) from different continents,
- Two billion, 1825 – 1927: Introduction of science to control plants and pests,
- Three billion, 1927-1960: Invention of the gasoline tractor, cheap nitrogenous fertilizer and other mechanized agriculture equipment,
- Four billion, 1960-1975: Development of dwarfing genes in wheat and rice (a major contribution to 69% of the next billion people in Asia,
- Five billion, 1975-1986: The increase usage of fertilizers including; nitrogen (440%), phosphorus (317%) and potassium (210%), as well as increases in irrigation in developing countries by 82%
- 7.3 billion, 2016: Genetics, biological control and precision farming.

(Evans, 2001; FAO, 2016; U.S Census, 2015).

A variety of influences are at work in the current food system (CFS) and, however unlimited the growth potential of the global population may seem to some, the CFS supporting this expansion is potentially supported by finite resources, as this thesis will identify.

The literature review will discuss the CFS, the impacts of the Retail Food Service Outlets (RFSO) as well as strategies and programs attempting to minimize or mitigate some of these impacts.

The research then investigates responses from the main actors that make up the RFSO including: business owners, investors, chefs and waitstaff through a series of interviews and surveys in an attempt to identify the sustainability performance of the individual actor and the RFSO they represent.

2. Literature review

2.1 Food demand, food systems and their sustainability: Then, now and into the future.

In this section a brief history of global food demand and the evolution of industrial agriculture systems and innovations is explained with a focus on the drivers of identified trends and the sustainability of these drivers. Ecosystem services are identified as major inputs into the food system as is the impact they are having on the natural environment. In the context of feeding the global human population, this section examines whether the volume of food produced is sufficient for this purpose, or whether the distribution of this food, food wastage, and emerging competing uses for agricultural products lead significantly to malnutrition, under-nutrition and hidden hunger. The need to understand the impacts of climate change on the pattern of agricultural production and adapt to these changes are discussed. The case is then made as to the increasingly important role of RFSOs in the food production system in developed countries, and how this sector of the food system has not been the focus of as much research as others.

Despite the common perception that the green revolution was a positive outcome to feed the worlds growing population there is argument it has helped create an unsustainable food system that is environmentally damaging (particularly in the long term) through its overuse of natural resources (Dobbs and Pretty, 2004). According to Evans (1998. P226) *"the world's population has long since passed the point where reliance on self-sufficient agriculture is possible, reaching three Billion was the turning point"*. Between the years 1961 and 2007 world agriculture production tripled whilst population doubled, and this was achieved with only an 11 percent increase in net area (Pretty, 2011).

As the human population continues on its projected growth trajectory to nine Billion by 2050 (FAO, 2016), and keeping in mind the resources such as food, water and energy required to maintain this growth, it is reasonable to suggest the current methods of food production cannot sustain the growing population.

The diagram in Figure 2, from Evan book *Feeding the Ten Billion* show the available arable land has plateaued all the while human population, fertilizer consumption and cereal crop yields continue their upward trajectory (Evans, 1998).

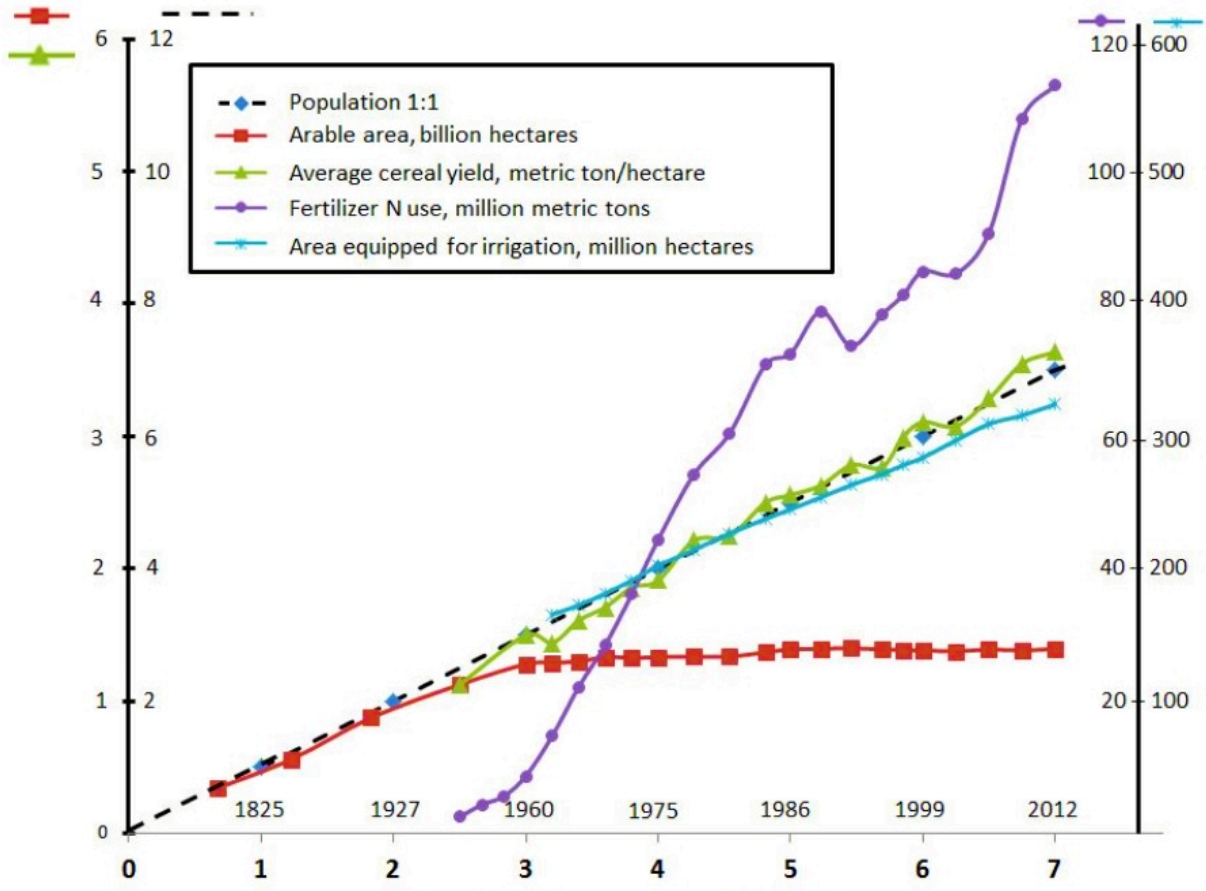


Figure 2: The relation between world population, arable land, average cereal yield, N fertilizer use and irrigated area. Image: Feeding the Ten Billion, Plants, Population and Growth, Evans 1998 Cambridge University Press (supplemented with data from FAOSTAT.

2.1.1 Consumption patterns of the Agri-Industrial system

Industrial/ intensive livestock farming is the major method used in attempting to satisfy supply of consumable animals with consumer demand, and the term agri-industrial used to describe the CFS as it represents the combination of agriculture guided by an economic model using industrial processes of mechanical and chemical means. The CFS has evolved to supply consumer demand and as research clearly shows it also

influences consumers eating habits (Guyomard, et al. 2012; Henchion, et al. 2014; Johnston, et al. 2014; Pingali, 2007). Further, not only is the population growing it is also eating more per capita, particularly in the developed world. The Australian Institute of Health and Welfare report Australians are eating more calories and increasing in average weight and obesity levels. In the four-year period between 2008 until 2012 the rate of overweight males has risen from 67.7% to 70.3%, and women an increase from 54.7% to 56.2%. In the 17-year time period from 1995 to 2012 a 10% increase in general over-weight figures was recorded (AIHW, 2015).

Consumption habits are essential in understanding the sustainability of the CFS as it enables identification of future trajectories in regard to its capabilities and capacities. In particular, the increased demand on ecosystem services for proteins such as meats and eggs consumed per capita is a key emerging issue.

Research shows that in 1961, with a global population of just over three billion people, annual consumption was an average of 23kg of meat and 5kg of eggs, by 2011 these figures have increased dramatically to 43kg of meat and 10kg of eggs consumed by seven billion people (as shown in figure 3).

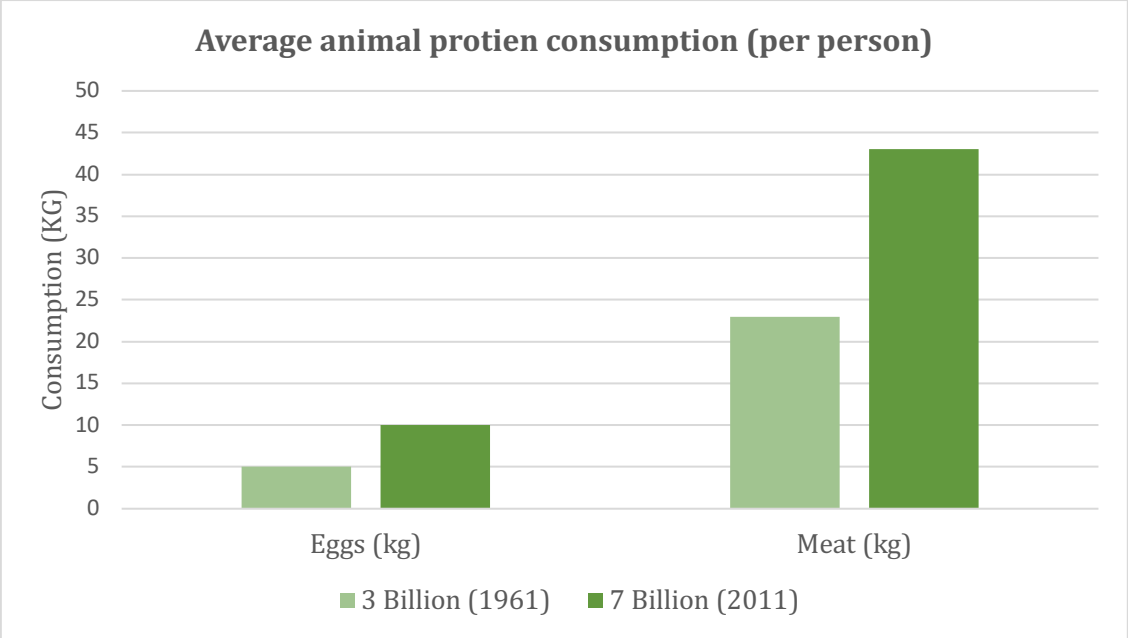


Figure 3. Consumption of animal protein per capita 1961 and 2011

Although at a glance these figures may suggest the main problem is a doubling of meat and egg consumption per person, the increases in population means these figures are in fact a quadrupling of the meat and egg demand.

Chicken eggs are a globally recognised common staple and in this paper they are used as an indicator of market growth and consumption, so it may be worth noting consumption around the globe is increasing a rate of one percent every year (TPS, 2014). In Australia, during the 9-year period 2004 – 2013 production of chicken eggs grew over 100,000 tonnes, from 138,600 tonnes to 240,925 tonnes (ABS, 2014).
Yet this demand for eggs is continuing to grow. Figures from the Australian Egg Corporation Limited (AECL) on 2015 production show new records yet again with that period producing 434,600,000 dozen eggs (AECL, 2015) or 306,000 tonnes. Broken down further into a more comprehensible figure shows this production rate to equate to 14million (13,850,958) eggs per day, or almost five hundred and eighty thousand (576,712) eggs per hour (AECL, 2015). However, as a reference these figures are dwarfed in comparison by the egg production of China, which in 2013, topped the global producers at 23,150,580 tonnes (FAO, 2013), over 70 times the output of Australian egg production.

The "meatification" of the Western diet is a term used to describe the industrial style production/consumption attitude of the current Western world (Weis, 2007), and also reflects the dietary aspirations of the emerging middle class in non-western societies such as China. In China alone, meat consumption has almost doubled in the past 20 years with projections for it to double again by 2030 (Scherr and Sthapit, 2009).
The FAO suggests that with an expected population of 9.3 billion people by 2050, and an increase of living standards, the global meat requirements will be in the vicinity of 52kg of meat per person (FAO, 2013), an unsustainable figure given the CFS requirements of natural resources already required to achieve this.

Although the agro-industrial methods of our CFS may seem to be producing enough product theoretically, figures suggest the current supply of food is having difficulty keeping up with total global demand (FAO, 2014). Limitations such as available agricultural land and freshwater supply are not the only challenges facing the food demand from the growing population.
A fundamental part of the human diet, grains and more importantly cereal grains are increasingly having to compete with the animal feedstock and bio-fuel markets. In particular, cereal production having peaked at 375kg p.c in 1984/85 and averaged

343kg p.c for the period 1980 – 2000, it is now expected to plateau between 360kg p.c and 375kg p.c by 2050 (Alexandratos, 1999; Gilland, 2002).
Although the demand from the bio-fuel sector is expected to continue, advancements in technology and agricultural biology may assist bio-fuel and animal feed sectors (Holman and Malau-Aduli, 2013; Popp, et al. 2016) in mitigating these impacts.

In an attempt to clarify some of the impacts associated with the increasing demand of meat consumption Tony Weis has explored the 'HoofPrint' of the various land animals in the global market. What may be of concern is the way in which humans have changed the natural cycles of these animals for the sole purpose of consumption. For example in the United States current records show more chickens are killed in one single day than was necessary for the entire year less than a century ago (Weis, 2013). In the last fifty years the population of the United States has grown roughly 50% (220 million 1977 - 325 million 2017/ USCB, 2017) yet chicken production has increased by 400% (9,279 million pounds 1977 - 41,000 million pounds 2017/ NCC, 2017), displaying a growing disparity in the CFS supply versus demand.

With the growing population consuming more than ever before and a shift towards more meat-based diets by developing economies (Bajzelj et al. 2014) the sustainability of the CFS should be of major concern as too the major inputs enabling its capacity for continued growth.

2.1.2 Key Inputs into the Agri-Industrial System

Regardless of the agricultural food system processes favouring industrial efficiency many of these have environmental impacts including land clearing, water use, and typically the use of fertilisers. These impacts can in turn reduce the long-term productivity of arable land, or indeed the area of arable land itself, as well as causing impacts to downstream waterways and greenhouse gas concentrations.

In the quest to maximize yields focus may also need to address the current reliance of fossil fuels in today's agriculture, the need for greater efficiency in synthetic fertilizers, as well as exploring ways to prevent the growing problem of soil nutrient stripping (Jones et al. 2013). As crop demand intensifies nutrients are exported from the land (in

the form of crops) with no capacity to replenish. Attempts to combat these nutrients losses through adding varying and excessive amounts of nitrogen (N), phosphorous (P) and potassium (K), can have the opposite effect causing excess mining[1] of micronutrients (Sheldrick, et al. 2002) without replacing the other ten or so essential nutrients and several micronutrients demanded by plants (Welch and Graham, 2004). Soil degradation has been directly blamed for the malnutrition and hidden hunger[2] of up to 3.7 billion of the world's population (Lai, 2009), yet research in this area suggests the practice of fortifying crops with essential mineral elements is achieving some success (White and Broadley, 2005; Mayer, et al. 2008).

Although there are many inputs essential to CFSs projected growth, the three major challenges discussed in relation to this paper are:

- fossil fuels; for energy, transport,
- synthetic fertilizer; Nitrogen, and
- fresh water.

all of which are finite resources (Patron, 2015).

2.1.2.1 Fossil fuels

While the source of energy for plant production is obviously the sun, in modern food production systems there are other requirements for energy input. It is undeniable the major role oil plays in our CFS and the success it has played in feeding the growing population (Evans, 2010), although there is growing concern relating to the negative consequences arising from the food systems dependency on this fossil fuel (Brown, 2012). Current estimates reveal that 10-15% of total energy used in industrialized countries is for the food sector, with only one quarter being on-farm use (Evans, 2001). Current food production has seen advancements in mechanization, predominantly powered from energy derived from fossil fuels. The use and actions used to extract fossil fuels from the earth have been shown to cause environmental and human health problems. From the much-publicised Exxon Valdez oil spill in 1989 to the more recent gulf oil spill (Deepwater Horizon) of 2010 which leaked an estimated 3.19million barrels of oil into the marine environment (Atlas and Hazen, 2011), environmental

[1] Nutrient mining or negative balance occurs when nutrients are removed with cultivation and then nutrient re-application are either imbalanced or inadequate (Majumdar, et al., 2016).
[2] Hidden hunger is a result of macronutrient deficiencies in the diet responsible for malnutrition.

damage from fossil fuel accidents can be of major significance to fragile eco-systems (Carson, et al. 2003) for many years, or in exceptional cases for decades to come (Kingston, 2011).

If one were to agree with the statement the age of cheap fuel is over, it may also be reasoned so is the age of cheap food. Evidence indicating the tipping point in fossil fuel peak extraction has been reached and now the major focus is on renewable energy and other alternatives (Dresselhaus and Thomas, 2001; Farret and Simões, 2006; Bhide and Monroy, 2011). Originally oil, coal and gas was economically cheap to extract and refine (Hilson and Murck, 2000; Rankin, 2011), and as a result it played a major role in defining the CFS. This perceived abundance however may have encouraged industry to use this valuable resource without factoring in the many externalities impacting the natural environment and as a result, there are now growing environmental consequences (Rosen and Dincer, 2001) which will essentially impact the CFS ability to operate as it has done.

It is without argument fossil fuels have enabled the strong growth of the CFS to the levels it is experiencing globally. Yield per hectare was once dominated by land management practices, however the use of fuel for machinery and artificial fertilizer has seen the CFS evolve into today's efficient agro-industrial system. The oil, coal and gas used to create the energy for production, processing and manufacturing along with energy required for the fertilizers and pesticides has also many negative environmental impacts which may not have previously been of major concern (Gill and Garg, 2014).

Mining for fossil fuels and the burning of them to release energy is undoubtedly one of the most environmentally damaging acts out of all the global industries (Hoekstra and Wiedmann, 2014). Negative externalities include water and air pollution, biodiversity loss, long-term damage to fresh water reserves and land degradation (Butt, et al. 2013; Litterman, R. 2015).

Due to the variety and extent of oil required in most steps of the CFS lifecycle it may be fair to reason, to an extent, we are eating oil (Jones and Woodward, 2001; Pfeiffer, 2013). This reasoning may be justified because oil is the unrefined base of gasoline and diesel which is currently essential for tractors, trucks other agricultural related

machinery. Oil is also the main ingredient required for the production of chemicals used as fertilizers and pesticides, lubrication in machinery for transport and processing, and also the base for plastics in packaging and production equipment (Pimentel, 2006). Aside from the environmental risks in extraction and transportation the burning of oil for energy can also pose serious health problems. Air pollution from the gaseous form of oil and its derivatives, namely the category of persistent organic pollutants (POP) can greatly reduce quality of life by contributing to a wide range of degenerative diseases which can also result in death (Abbas, 2013; Jones and de Voogt, 1999; Kampa and Castanas, 2008).

Although a contentious topic for governments and corporations alike, the total effects from the burning of fossil fuel has and will continue to shape the pattern of global food production.

2.1.2.2 Fertilizer – Nitrogen

The perception of cheap fuel encouraged cheap energy, and the invention of artificially fixing atmospheric nitrogen into reactive nitrogen for ammonia (Preininger and Gyurján, 2001), although energy intensive, synthesized a once naturally restricted compound, essential for plant growth, into a readily available and cheap fertilizer which changed the history of food production. Whereas before the discovery yield per hectare was governed by ambient natural parameters and traditional land management, the breakthroughs in synthetic conversion of nitrogen for fertilizer production have been so monumental it has been credited in enabling the increase in human population by an estimated 48% (Galloway et al. 2002; Galloway and Cowling, 2002).

In 1908 the area of 1 Hectare (1ha2 =10,000m2) was large enough to support 1.9 persons, yet through advancements in food production, including synthetic fertilizer development, by 2008 that same area was able to support 4.3 persons (Galloway, et al. 2003).

It may be reasonable to suggest that so great is the dependency of the CFS on the synthesis of ammonia from atmospheric nitrogen it is the greatest single factor that has transformed the current world population (Erisman, et al. 2008). Figures suggest there is 112 Million Tonnes of reactive Nitrogen (N_r) naturally occurring in the environment,

however through the impacts of artificial fertilizer and the burning of fossil fuels, these two processes add an extra 190 Million Tonnes to the equation, creating a combined total of 302 M/T N_r in the environment (Erisman, et al. 2008).

Although nitrogen is an essential element for life, and its cycle plays an important role in the food system (as shown in figure 4), excess amounts of N_r are responsible for growing environmental impacts which include; increasing greenhouse gas, air quality reduction, acidification of soil & water ways and eutrophication of marine and freshwater environments (Sutton et al. 2011; Davidson et al. 2011).

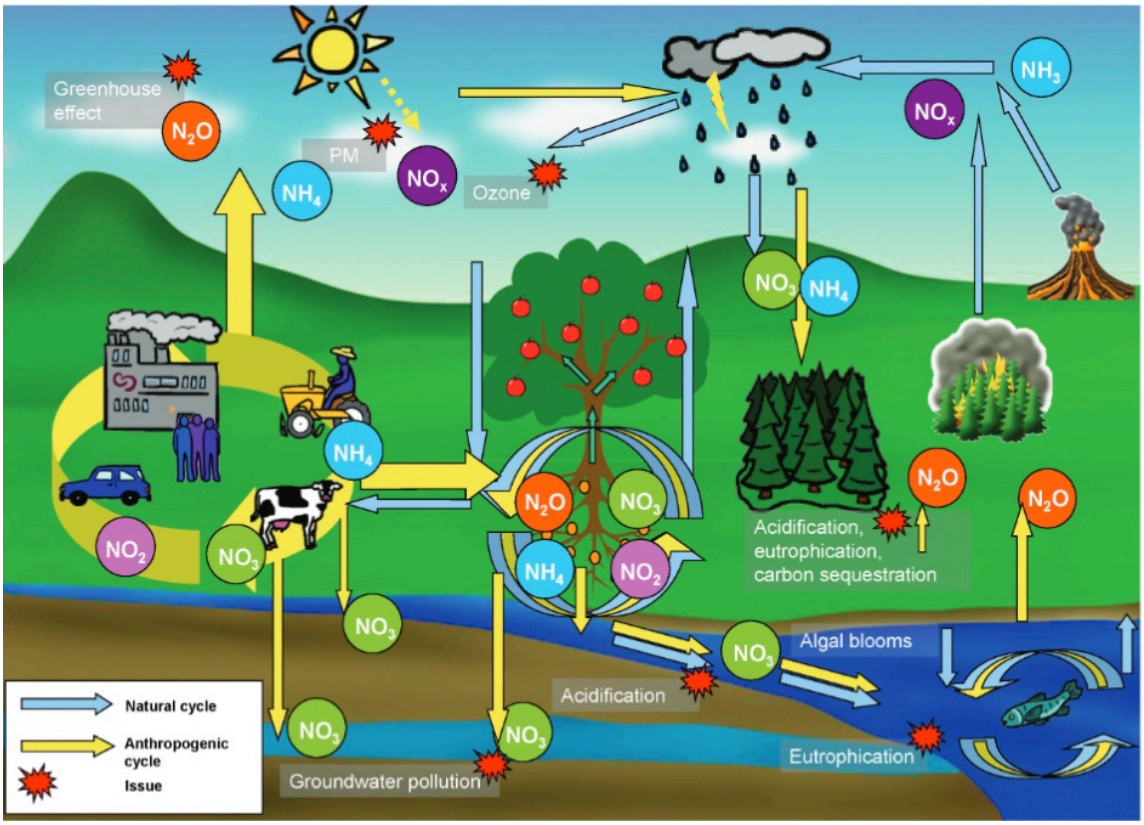


Figure 4. The reactive nitrogen cycle, drawing credited to Anne-Christine LeGall; Erisman et al, 2011, The European nitrogen problem in a global perspective.

In this reactive form it is also easily transported between air, water and soils and these acid depositions can then corrode man-made structures such as buildings and bridges (Braun, 2007). Due to its ubiquitous nature and its ease to form with other compounds to cause the 'nitrogen cascade' (Erisman, et al. 2013) there is difficulty in determining the extent of specific human health effects. However long-term exposure to air pollution related to N_r emissions can be harmful and potentially fatal (Ricciardolo, et al. 2006; WHO, 2003; Wolfe and Patz, 2002), and can include; *asthma, respiratory disorder, inflammation of airways, reduced lung functions, bronchitis, cancers. (*Erisman, et al. 2013, ch2, tbl1). A study conducted by the Ontario Medical Association in Canada

concluded that excess reactive nitrogen and other pollutants cost more than $1Billion per year in hospital admissions, emergency room visits and lost work (Braun, 2007) suggesting global fertilizer health impacts maybe another externality the CFS needs to address.

2.1.2.3 Freshwater availability and quality

Fresh water is essential in the growing of most terrestrial food crops. The ability to harness the freshwater aquifers and waterways for irrigation, drawing water up from deep underground or high above sea level to irrigate has enabled crop production in arid climates where traditionally it was previously not available (Deng et al. 2006; Ghadiri et al. 2006) is a major factor in human population growth.

In assessing the natural limitations of the CFS fresh water availability is one of the major issues – both environmentally and also for society. Locally and globally freshwater scarcity is increasing in importance as there are many signs that the current use of the world freshwater sources are not replenishing or recharging in time to the excess demand on them, bringing these bodies of freshwater to exhaustion.

Although advancements in technology has enabled the development and cost of desalination plants in remote and arid regions to alleviate water scarcity, initial cost and ongoing infrastructure maintenance, may mean this form of technology for the moment remain out of reach for most regions and in particular in most developing countries poorer regions (Mathioulakis, et al. 2007).

As examples of declines Lake Bakail in Russia, the home of the world's largest inland body of freshwater, by volume, and a UNESCO world heritage site, water levels are now so low experts are calling it an international crisis (Timoshkin et al. 2013; Dudgeon et al., 2006). The lake has traditionally supported many forms of food production including fishing and irrigation for agriculture and is now so heavily effected by human and natural pollution the lake and surrounding environment is under threat. Although it may be reasoned the shrinking of the world's largest freshwater reserves in Russia (accounting for 20% of Earths unfrozen freshwater)(Semovski, et al. 2000) maybe a rare occurrence, data would suggest the shrinking of the world's largest freshwater lakes seem to be a growing trend around the globe (Beeton, 2002; Dudgeon et al. 2006). In Iran, home to the world's second largest freshwater lake, Lake Urmia, water levels

have dropped to the lowest level ever witnessed (Abbaspour et al. 2012; Eimanifar and Mohebbi, 2007). At Poyang Lake, once the largest lake in China, water levels have dropped to the extent that surrounding industries including tourism have been significantly impacted. The building of the world largest dam, the Three gorges reservoir, and an on-going drought have been blamed for the environmental disaster (Song and Ke, 2014; Feng et al. 2013).

The UN states that by 2025 potentially 1.8 billion of the population will suffer from absolute [3] water scarcity (FAO, 2015), while separate research from Wallace confirms these figures as he projected up to 67% of the global population would suffer from water scarcity by 2015 (Wallace, 2000). In relation to water scarcity and food crops statistics show up to 80% of ground and surface water in the United States is used by the agricultural industry (USDA, 2016), whilst similarly figures suggest 60% of all water use in Australia is for food production (Lenzen and Foran, 2001).
It is estimated that in the early nineteenth century each person's daily demand for fresh water was in the vicinity of 10-20 litres, today the total average daily requirement is 200 litres (Allan, 2011). This may cause concern to those who realize, dependent on geographic location, humans only need an average of 3 litres of water for survival, yet the water required for our food needs, crops, livestock, processing is multiplied by one thousand (x 1000) to get a more accurate figure (Liu, et al, 2016; Mekonnen and Hoekstra. 2016). Using this method of calculating water needs each person on the planet requires an average of 1200 cubic metres per year to produce the current food requirements (Allan, 2011).

Not only are fresh water reserves being depleted faster than they can naturally replenish the contamination and pollution of the aquifers is also of major significance. Contamination of water can come from many inputs, however industrial contamination and excessive fertilizer and pesticide run-off from agriculture are the two major contributors to the freshwater availability challenges (Holt, 2000; Danielopol, et al. 2003). Polluted water run-off is a negative externality of agriculture partially due to the excessive amounts of fertilizers and pesticides washed from the land into streams and

[3] Absolute water scarcity is the definition used to describe the fresh water availability being less than 500m^3 per person per year (Falkenmark, et al, 1989).

estuaries or seeping into underground water tables and aquifers (Ritter et al. 2002). Coral reefs in general are susceptible to excess nutrients from agricultural run-off. In Australia agricultural runoff has been identified as one of the significant causes of the coral bleaching to the Great Barrier Reef (Brodie, et al. 2012, De'ath, et al. 2008, Wooldridge 2009) and it is also recognised as a threat to seagrass habitats around the globe (Grech, et al. 2012).

The Great Barrier Reef with its coral reef and extensive seagrass beds is an essential part of the marine environment providing many different forms of habitat to a large range of commercial and endangered marine life (Roberts, et al. 2002). Although the Great Barrier Reef is largely recognised for its importance for marine diversity, all coral reefs around the globe play an essential role in marine habitat, with figures suggesting they are home to one out of four marine species (FAO, 2015).

Research indicates the chemical pollution impact from food production is so great it is changing the acidity of the world's oceans (Gruber and Galloway, 2008). The full future impact of the oceans acidification is difficult to determine as many of the laboratory experiments are not able to create the multiple environmental variables or observe possible adaptations in the short-term (Doney, et al. 2009). However, many studies on the impact of acidification on calcifying species, which include crabs, corals, oysters and clams, claims it can have devastating effects the marine environment (Kroeker, et al. 2013), which in turn affect its harvesting potential.

In addressing alternate methods for accessing freshwater in the future continued research into solar distillation and atmospheric condensation may enable poorer regions another way to access fresh water without some of the traditional desalination challenges (Devi and Sekhar, 2016; Scrivani, 2007).

Water footprint

The water footprint is a model credited to Mekkonen and Hoekstra (2011) and used to measure the actual water consumption of a given food, area or group of people. The model calculates the footprints of blue, green and grey water consumed or lost, throughout the lifetime requirements of a particular product. According to these researchers nearly one third of the total water footprint in world agriculture is related to the production of animal products (Mekkonen and Hoekstra, 2012). A common

example of this method is the projected water requirements of 1kg of beef. Figures that include the water required to grow the feed and process the animal throughout the lifecycle conclude the average water consumption to be in the vicinity of 50,000 litres of water per 1kg beef (Hoekstra and Webster, 2010). Although this figure is a global average and includes the feeding of beef through feedlot raising; the researchers have also developed averages for each country dependent on the main form of production. Many crops deemed essential for animal feed are grown using intense farming methods which include large scale single-crop farms responsible for using large amounts of fresh water, fertilizers and pesticides, and these are incorporated into the water footprint equation for the 1kg of beef result.

In attempting to better comprehend the importance of the water footprint, the concept of virtual water may assist in the process. It recognizes the water embodied in products and the importance of the water rich nations trading water intensive products with water scarce nations (Allan, 2011). This concept may become more relevant when one considers although Australia ranks as one of the top exporters of virtual water in global trading (Allan, 2011) it is also recognized as the driest inhabitable continent on the planet (SOE, 2011).

The world's Top 10 Freshwater consumers by country and use, and also the top five importers and exporters of virtual water is shown in Figure 5. What may be of interest is the country of Japan, an island style country surrounded by water, recognised globally for its geography to include huge snow and rain fall, yet is the largest importer of virtual water in the world, distancing itself from the other top four countries by over 50,000 million m^3 per year.

2.2 Current Food System costs

Due to the scope and size of the CFS it is extremely difficult to gain an exact economic figure, however the world bank estimated the value of global food sales in 2007 at US$4.8 trillion dollars (World Bank, 2008; Meade, 2012) when the global population reached 6.6 billion. With the current population at 7.6 billion (PRB, 2017) it is fair to reason the value of global food sales and production has followed suit.

There is strong reason to suggest that the modern agro-industrial food system origin was formed after the Second World War in 1945, with the global integration of western style food franchises (Sage, 2011). In an attempt to utilise war surplus and create food and jobs for the returned soldiers many governments turned to farming solutions that encouraged greater yields than ever previously experienced.

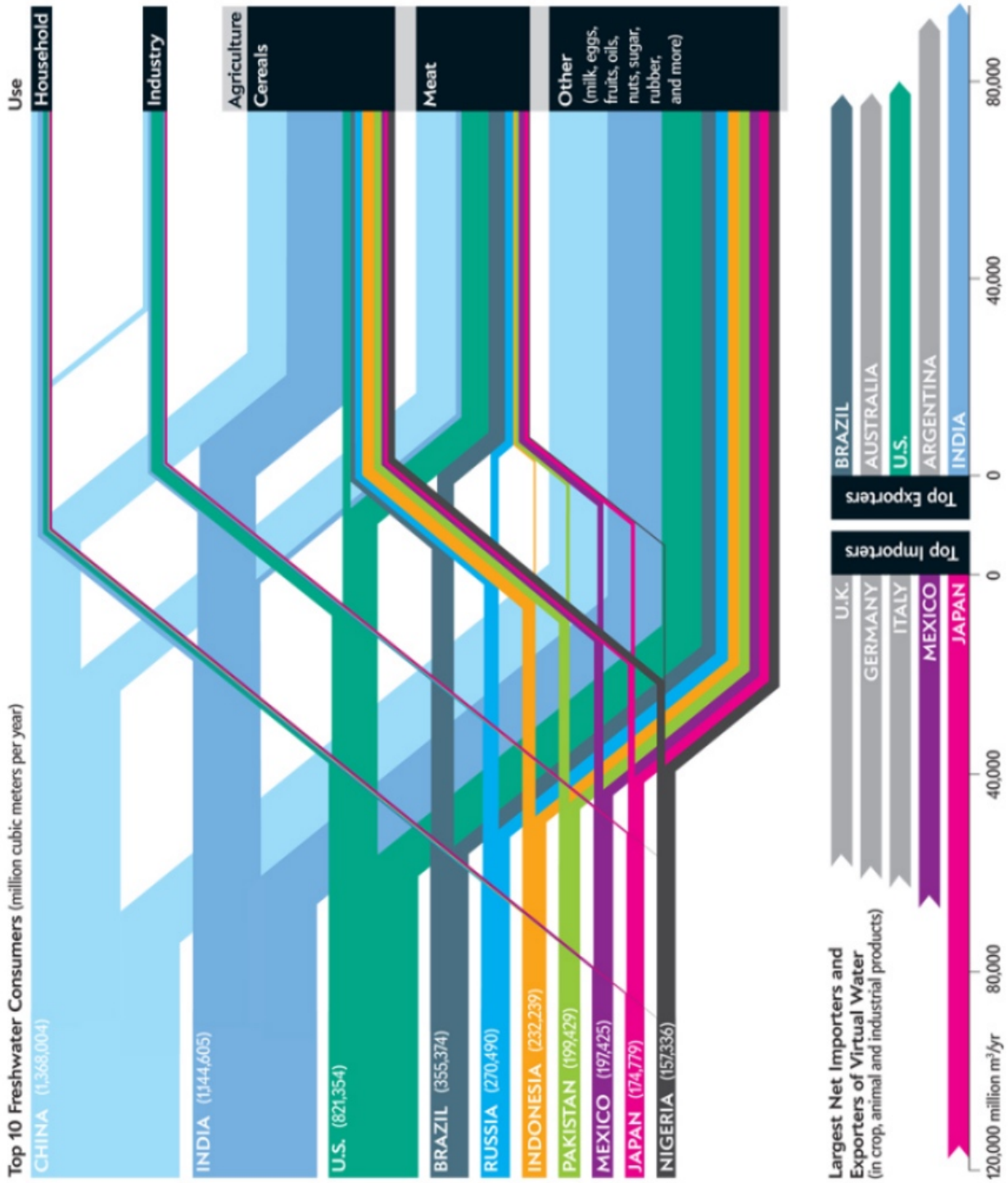


Figure 5. Global water usage, picture credit to Jen Christiansen; Hoekstra and Mekonnen, 2012, "The Water Footprint of Humanity".

In the UK a highly regimented approach was adopted requiring maximum output from the land that was so severe that between 1947 and 1958 over 400 farmers were dispossessed from their land and 5,000 more were placed under supervision orders for failing to comply with mandated intensification standards (Clunies-Ross and Hildyard, 1992). This may be the starting point that food production changed from a locally managed resource to a large economically driven system with a focus on the volume of production which we identify as the CFS.

Furthermore, due to economic efficiencies in total supply chain management, this agro-industrial central market system assisted the creation of global food corporations, which have largely been shaped by mergers and acquisitions of local and international brands to increase the efficiency of particular food supply chains. Yet the question must be asked, is this CFS economically and environmentally sustainable?

Roling and Pretty (2005), identified that one of the key drivers of the current agri-food system: is the way commercial interests have effectively appropriated resources and technologies previously in the hands of farmers (eg: soil fertility, seeds,) to become industrial inputs subject to innovation and scale enhancement. Through the complete management of all major inputs in food supply chains; capital, seeds/fertilizers, transport, storage, packaging, processing and manufacturing the maximization of outputs may be achieved. Yet however economically efficient this model may seem in theory it may not take into account natural cycles and negative externalities of the practical model.

Roling and Pretty (2005) also indicate the farmers traditional approach to managing the land recognizes the long-term value of the natural cycles in an attempt to get sustainable and consistent results. Whereas it may also be reasoned the industrial model has not included a real economic value of the natural cycles or eco-system services, and as a result this model is depleting the natural services quicker than they can be replenished.

2.2.1 Eco-system services

Eco-system services is a term first coined in 1997 to describe the benefits provided to humans through the transformations of resources (or environmental assets, including land, water, vegetation and atmosphere) into a flow of essential goods and services such as clean air, water, and food (Constanza, 1997). Ecosystem services function by the continuous cycling of materials and energy through living organisms in response to stresses and ecological interactions and some forms can include the carbon, hydrological, nitrogen and phosphate cycles, some of which can take thousands of years to complete. The concept of ecosystem services being economically valued is increasing in importance as society understands and acknowledges the services provided and that all the natural systems are interconnected.

Ecosystem Services Valuation (ESV) is the process of assessing the contributions of ecosystem services to sustainable scale, fair distribution, and efficient allocation (Laurans, et al. 2013). However ideal as this may seem in theory, due to the complexity of ecosystem services and the often competing and conflicting objectives (Robinson, 2012) mutual global agreement on an economic value on the common goods and the benefits provided is proving to be a major challenge in broad implementation of this concept (Laurans and Mermet, 2013). Of direct relevance though as a methodology, a lifecycle assessment (LCA) approach is the most comprehensive and relevant in attempting to quantify the economic contribution of ecosystem services (Xhang, et al. 2010), and this includes acknowledgement of the potential loss of the services provided as well as the profit.

Damage to ecosystem services can come from a range of factors and includes natural occurrences such as flood and fire or anthropogenic disturbances such as land-clearing for agriculture or urban development. Although at first it may not seem these impacts on the natural environment as a whole are obvious or consequential, long-term impact to the ecosystems including loss of pollination insects, soil fertility, erosion and eutrophication, and these can be environmentally, socially and economically devastating (De Sherbinin, 2007). According to Das in his 1979 publication*; What is the value of a tree*, by taking into account various aspects such as; oxygen production, soil erosion mitigation, soil fertility, water recycling, animal/ insect shelter, and air pollution control he theorized a single tree's ecosystem services over a 50-year period could be as much as US$196,250 (Das, 1979). After revision in 2011 which updated the

total to US$710,260 (Greenearthappeal, 2015), including inflation of 1.63% for the years 2011-2017(Inflation 2017) and a current exchange rate of US$0.74 (RBA, 2017) the total in today's value would be AUS$1,574,503.
While the exact value of an individual tree's ecosystem service is dependent on the species and a range of contextual factors, the value obtained by Das (1979) highlights that understanding the total contribution may be more complex than a gross material estimate. Looking in a global context, the ecosystem service provided by pollinators in 2005 was estimated to be 153Billion Euros (Melathopoulos, et al. 2015), and further research suggests this value is rapidly rising (Lautenbach, et al. 2012).

Globally, it is estimated that 23–24% of total use of all water, cropland and fertilizers are used to produce losses (Kummu, et al. 2012). Reading these figures it is reasonable to conclude the lack of agreed value globally for ecosystem services, the reliance of cheap fertilizers, cheap fuel and seemingly unlimited water supply has created a type of false economy where food is traded as a commodity and excess food is discarded as waste (Nellemann, 2009).

2.2.2 Food corporations and potential social impacts.

Although food waste can be perceived by some as one of the major challenges facing the sustainability of the CFS, food inequality and the growing disparity between the agri-industrial food corporations and small farm families can also be a factor in its sustainability. Workers from developing nations not able to afford traditional food staples grown on their land are now facing obesity epidemics amidst malnutrition and starvation (Albritton, 2009, Nelson, 2017) suggesting social sustainability given greater consideration when identifying externalities of multi-national food corporations.

Where small multi-purpose farms once provided the nutritional requirements essential for rural living there is proof the CFS support of the agro-industrial model is changing the future of rural towns and communities (Bellows et al. 2016; CFS, 2015).
The country of Brazil as an example; a land extremely rich in natural resources, huge freshwater reserves from the Amazon basin, tropical climate and fertile soils is theoretically ideal to sustain its population from healthy and local food production. Supporting figures suggest Brazil is a dominant figure in global food production and

recognized in the top three in the world for the production of beef, sugar, coffee, cassava and soy. It is also a major player in pork and chicken production as well as animal feed production, scoring it number two in the world for agricultural exports, totalling over US$90billion (WTO, 2015).

However, while most economic statistics look favourably to this country displaying huge food wealth, research suggests an estimated quarter of all Brazilians live in poverty, on less than $1US per day (WorldBank 2008) creating an environment leading to household food insecurity (HFI). Although traditionally poverty has been associated with undernutrition research is now showing a correlation between poverty and obesity (Kursmark and Weitzman, 2009). Poorer families are eating higher fat and energy rich foods that are more affordable and more effectively marketed than ever before (Swinburn, et al. 2011). Research from Brazil shows women from moderately food insecure households were at 49% higher risk of obesity compared to their food secure counterparts and the risk of obesity increased with the severity of food insecurity (Kac, et al. 2012, Schlüssel, et al. 2013).

Further evidence to suggest an imbalance in Brazil's food system are figures claiming that three percent (3%) of the population controls two-thirds of all the arable land (Sage, 2011). This data seems to suggest that although the land itself is currently supporting food production on a massive scale, the food produced and wealth made from its sale is not be benefiting the general population (Bardhan, 2006).

The food sector as a whole, including companies that supply critical inputs into agriculture production, is characterised by a concentration of ownership among relatively few commercial entities. An example of the growing imbalance in the processed food product category *Figure 6.* highlights the concentration of brand ownership by the ten major food companies.

In economics terms a four-firm concentration ratio (CR4) represents the four firms responsible for the largest total output of a particular product within that industry (Hendrickson and Heffernan, 2007). When concentration of ownership rises above 40% competitiveness begins to decline and this can encourage anti-competitive behaviour. This is essential in attempting to understand the current global agri-food system as data

suggests the majority of food currently produced in this sector by CR4's are well in excess of the 40% ratio (Sage, 2011).

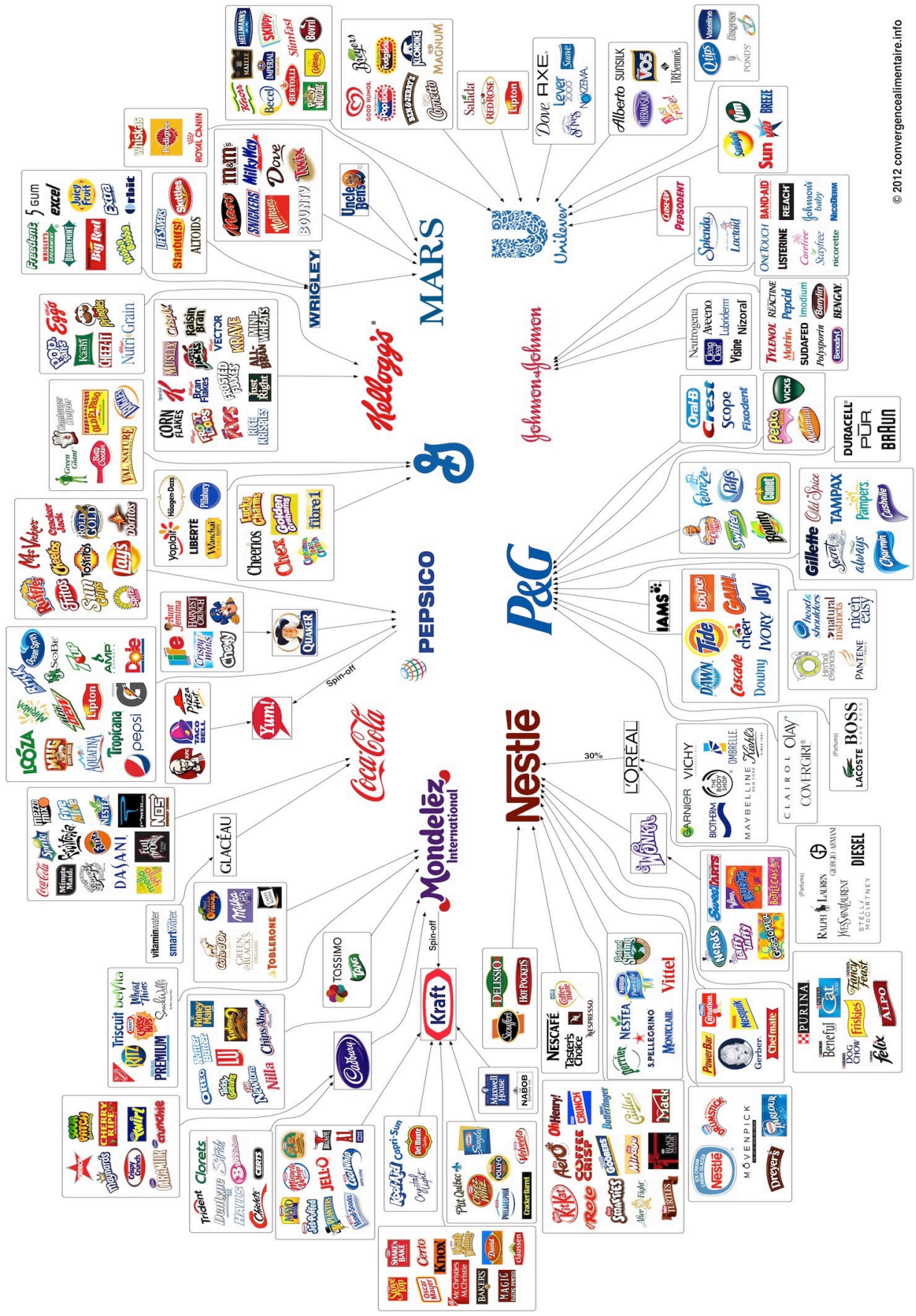


Figure 6. The Big 10, Behind the brands: sourced from http://convergencealimentaire.info/

Approximately 80% of the world's agrochemical market, which also include seeds and veterinary products, is controlled by only six companies (Dinham and Pretty, 2005). In the U.S research suggests two food corporations, ConAgra and Cargill, are involved in nearly every stage of pork production apart from rearing, including; grain farming, grain transport and processing, livestock feed manufacturing, meat packaging and processed foods production (Welsh, et al. 2003) and 75% of the US pork industry is owned by just 4 companies (Halverson, 2015). In Australia the 'big 2' supermarket companies, Woolworths (38.5%) and Wesfarmers (Coles) (31.8%) represent a controlling 70.3% of market share. Although the food retail landscape may be changing with Aldi (11.6) and IGA (9.5) (Morgan, 2015) the other two corporations to represent the suggested maximum CR4, the 40% threshold is significantly violated with a total ownership of 91.4% of the market as shown in figure 7.

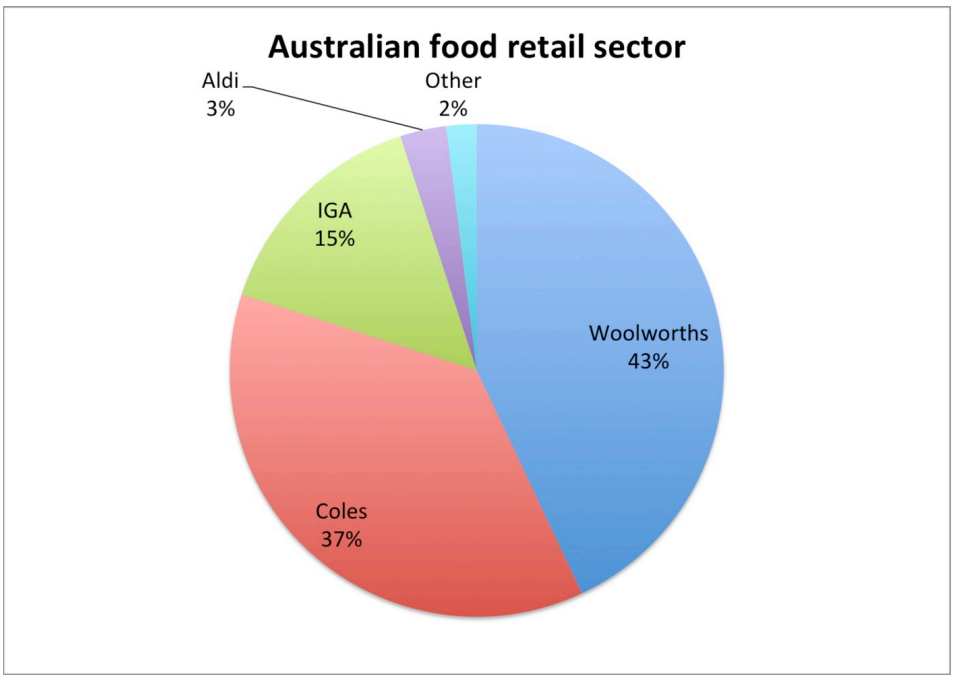


Figure 7. Australian Supermarket duopoly, Stuart Alexander, 2013

2.2.3 Food insecurity

The CFS has not managed to feed the global population as effectively as once planned. Although refined several times since originally being defined in the 1974 FAO Food Summit, Food security is: when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996).

Food waste and food loss is a recognised global problem with the United Nations estimating that over 1.3 billion people are undernourished, yet up to 30 percent of all food produced is wasted (Gustavsson, et al. 2011). The forgotten externalities of the seemingly cheap energy and cheap food may be one of the most important measures of increasing food security sustainably (Foley, 2011).
In an attempt to understand why up to one third of food is wasted yet over a billion people are undernourished, focus needs to be directed at the distribution of food and the definition of waste. Lipinski terms it best in that: Food loss is an unintended result of agricultural process or technical limitation, whereas, Food waste is a result of negligence or conscious decision to throw away (Lipinski, et al. 2013pp1).

Supply chains play a large role in the equal distribution of food and are arguably witness to both for food loss and food waste. In developed countries, where infrastructure of roads, rail, airports and refrigerated storage are a normal convenience, food wastage still occurs, although the distribution of the wastage may be defined differently. One method to better understand wastage patterns is to separate the waste into pre-consumer and post-consumer categories. In developing countries, where producers lack access to markets through poor infrastructure, storage and refrigeration, the major amount of food is lost before it has had time to get to the consumer (pre-consumer food waste) (Parfitt et al. 2010). In comparison developed countries have most challenges in the post-consumer stage, once the food has been purchased by the consumer (Parfitt et al. 2010). It is then fair to reason that in the developing countries waste represents a foregone income to the producer, whereas in developed countries it is a cost to the consumer. Gustavason et al. (2011) adds validity to this reasoning with his claims that food waste increases with higher levels of economic development.

2.2.4 Further contributing factors impacting the CFS

2.2.4.1 Bio-fuels

The trend towards bio-fuels for the transport sector maybe another challenge the CFS is facing. Where fossil fuels may rightly have an image of dirty and polluting, bio-fuels may seem to represent a greener, cleaner alternative, resulting in a more attractive option (Goldenberg and Guardabassi, 2009).

Plant matter is the main source of this biomass used and the major feedstocks used for biofuels currently are corn, wheat, barley, sugarcane, rapeseed, soybean and sunflower (Ajanovic, 2011). Many governments have offered incentives to encourage the adoption of biofuels including Brazil (Torres and Grundling, 2016), Nigeria (Abila, 2012) and the Unites States (Yacobucci, 2011), and for many this may seem like a reasonable solution for reducing the reliance on fossil fuels. However ideal this energy source may seem compared to fossil fuels, thought needs to be directed towards the wisdom of growing food crops for fuel when an estimated 1.3 billion people are undernourished (Conway and Wilson, 2012).

As fuel crops and food crops compete for the same resources food prices are becoming more and more coupled with energy prices. This occurs because biofuel policies create a new source of demand for land and water and the potential food source itself. (Freibauer et al. 2011; Schmidhuber, 2007). Some research identifies links between biofuels and global food prices, and this may be due to the majority of materials currently being used as feedstock, that can also be used as animal feed (Ajanovic, 2011). As the competition for resources increase so to the key negative impacts of biofuel use including food price increases, greenhouse gases emissions and threats to forests and biodiversity (Koh and Ghazoul, 2008).

Although the use of fossil fuels is widely recognized as helping shape the current agri-food system the steady growth in renewable energy may also be influencing the drop in the cost of fossil fuels. Adding to this is figures suggesting global fossil fuel subsidies are in the vicinity of US$500Billion per year, and it may give reason to the turn-around in investment of both the fossil fuel and renewable fuel markets (Heal and Hallmeyer, 2015; Klevnäs, et al. 2015).

2.2.4.2 Natural limitations

Resource constraints are another of the major challenges facing the CFS. Earth's natural resources are not infinite and Kennedy and Harris (1999) identify that in terms of agricultural carrying capacity the world is close to its ecological limits on soil fertility, water availability and nutrient uptake. Traditionally one of the keys to agricultural growth was available fertile land, therefore managing land use is an essential part of

global development. DeFries et al. (2010) suggest international demands for agricultural products and not rural population growth is the main driver of forest loss and deforestation, so it may be the capabilities of the earths land suitable for food production that needs addressing.

Global estimates suggest land currently under cultivation is at 1.5 billion hectares (1.5 x 10 x $3m^2$), a significant amount when one considers that over the past 40 years around 30% of the world's arable land has become unproductive and been abandoned for agricultural use, and an estimated two billion hectares of arable land has been abandoned since farming began (Pimental and Pimental, 2003).

Although the many species alive today have evolved and adapted to man made changes there are species in nature that cannot adapt as quickly as the synthetic environments that are forced upon them. Natural limitations can also be affected by mismanagement of natural resources including land clearing and water way pollution.
In Australia almost two-thirds of land has been modified for human uses, primarily grazing of natural vegetation, with over 89% of farmers managing weed issues using herbicides, burning, cultivation, slashing, cutting or crop/grazing management (ABS and Statistics, 2010). Tree/ ground cover loss is a major factor in terms of soil health and can cause erosion and flooding which in extreme cases can lead to desertification (Gambin and Lambin 2004) and the inability for the soil to absorb excess water and nutrients (Molina, et al. 2007).
Furthermore, man-made influences can impact the limitations of nature's resources on a much greater scale as anyone discussing the topic of climate change will be aware.

2.2.4.3 Climate change

Climate change and its impacts is arguably the most contentious of all challenges facing the CFS. Climate change impacts a number of factors critical for agricultural production. Some projected effects of a changing climate include more severe and frequent weather events (e.g. cyclones and extreme heat) and earlier water cycles. Changes in season patterns and increased weather events can also extend pest infestations, encourage plant disease and impact agricultural yields (Rosenzweig, et al. 2001). The timing of flowering and fruit production and other impacts on biological processes critical for

plant production can change from these environmental processes (Craufurd and Wheeler, 2009; Bethere, et al. 2016) which may also impact the commercial yield of some crops.

Recent projections forecast atmospheric CO^2 will increase photosynthesis sensitivity and water use efficiency C3 crops[4] (FAO, 2016; Keenan et al. 2013) meaning plants farmed for major food crops cannot use water as effectively as farmed previously and can be more prone to heat. In research on impacts of increased temperatures on crops Lobell and Field (2007) suggest a clear negative response to wheat, maize and barley and since 1981 these effects are estimated to represent annual combined losses of 40Mt. This may be cause for concern when the FAO states current food production needs a 60% increase if it to feed the 2050 population.

Climate change is also projected to affect reduce renewable surface water and groundwater significantly in most dry subtropical regions (Jiménez-Cisneros et al. 2014) which can lead to drought conditions. Current climate change projection models may not thoroughly take into account the interconnected and delicate balance of the ecosystems and the severe impacts on pollinators, weeds and pests. Although the projected weather events can increase many threats to the current food system the improved living conditions of certain pests may also be a major factor. It is projected climate change can encourage prolonged lifecycles and geographic extent of certain pests including the desert locusts in Africa, potato leafhopper in USA, late potato blight in Finland and the coffee nematode Brazil (Cressman, 2013; Hannukkala, 2007; Ghini, et al. 2008).

The climate change impacts on plant pollinators (bees, birds, bats and other insects) pose substantial potential significance to global food security. Pollinators are insects effecting 80% of all flowering plant species and include. Research shows there are 57 species important for global crop production with the majority of these being bees (Klein, et al. 2007). Gallai et al. (2015) estimated that the actions of pollinators support $EU153 Billion of food production. Trees are critical habitat for many pollinators, and in addition they draw water up from aquifers, and protecting against soil erosion (Barrios,

[4] C3 plants represent roughly 85% of plant species and is a term used to describe one of the three metabolic pathways used by plants to fixate carbon in the process of photosynthesis, the other two being C4 and CAM (Kant, et al, 2012, Yamori, et al 2014).

et al. 2012). Concernedly Loo et al (2011) forecasts that forest tree populations are unlikely to be able to migrate sufficiently fast enough to keep pace with the changing climate.

2.3 RFSOs and their role in the sustainability of the CFS.

For this thesis the term RFSO represents retail food service outlets which services customers with a ready-to-eat meal and includes; cafes, restaurants, clubs, hotels, canteens, take-away food shops, food trucks and other small retail food vendors. These outlets are traditionally categorised under the tourism and hospitality sector, however due to sustained growth and the unique position of the RFSO it may help future accounts to become more specific.

2.3.1 The RFSOs influence in the CFS

With the global trend of more people eating meals away from the home there is a growing opportunity for RFSO to have a greater influence on consumers. Cooking shows, main stream media, multi stream advertising, social media and celebrity status all allow opportunities and influence to a large part of the RFSO market that has never been experienced in any other time in history. Although the status of the celebrity chef is not a recent phenomenon the wider variety of TV cooking shows as well as on the internet (e.g. YouTube), and increasing efforts by food media to push food products has them likened in some instances to Hollywood stars (Hansen, 2015).

For a brief historical example of the influence of the celebrity chef recognition must go to Marie-Antoine Carême (1784-1833), “the king of chefs”, who was one of the founders of haute cuisine, chef to royalty & high society in the early 1800’s (Snodgrass, 2004). Carême was known for his innovation and flair and was such a ‘food trend setter’ and his books are still recognised in professional kitchens around the globe, two centuries later. However, in terms of major modern influencers of the CFS recognition must go to Betty Crocker. Originating in 1927 when the Betty Crocker ‘recipes by air’ radio show first broadcast, the radio show was adapted to television in the 1950’s. Although Betty Crocker was a fictitious character created to encourage sales of baking products by the giant flour corporation General Mills (Ashman and Winstanley, 2007), however

research conducted 30 years after the first radio show suggests Betty Crocker was so popular 'she' was known to nine out of every ten Americans surveyed (Avey, 2013). Giving testament to the statement "food media is the new business of food" (Hansen, 2015), endorsing food and related products can generate substantial sums of money. Although difficult to get accurate data online searches suggests the top five celebrity chefs have an estimated combined net worth of over half a billion us dollars (US$500million) (Myers, 2015; Tableog, 2015). Although a fairly recent phenomenon without much accurate data on this subject, there is growing research on the role and importance of celebrity and television chefs and their influence on the modern consumer (Abbotts, 2015).

Traditionally it was fair to reason celebrity chefs become famous for their advanced cooking skills, however research suggest that the new role of celebrity chef is changing to one of an entertainer (Caraher and Dixon, 2015) and cultural intermediary (Piper, 2015). Johnston and Goodman (2015, pp.205) go further and suggest they may also have a *responsibility for their work to be authentic and aspirational, accessible yet exclusive, and empowering.* If this is true it may also be fair to reason the celebrity chef should be able to be a positive influence on the theme of sustainability.

The importance of celebrity chef's endorsements and "ethical capital" (Lewis and Huber, 2015) can be witnessed in the current competition between Australia's "Big 2" supermarkets, Coles and Woolworths (Morgan, 2015). As consumer trend grows in favour of ethical food and food provenance, food producers are reacting accordingly. Woolworths have recruited Jamie Oliver, the world's biggest earning celebrity chef brand. Successful because of his normality (Piper, 2015), his brand campaigns for healthy eating choices for children and greater animal welfare (Lewis and Huber, 2015). Curtis Stone, more a household name in the United States where he lives and works, has been recruited to be the celebrity chef and marketing voice of Coles, to promote the food provenance message. However measurable the success of these two chefs are, representing Australia's supermarket duopoly to eat more ethical and regional produce, there may be some grounds to question the campaigns authenticity considering both celebrity's live far away from the supermarkets intended audience, in separate overseas countries.

Yet it is not just the celebrity chef who has influence over the consumer and according to Hansen (2015, pp.50) where: *the new food media creates a base of consumers whose appetites are literally and figuratively kept wanting*. From the obvious marketing of food to consumers in media, to being suggested a menu special from a food outlet staff member, the business of food influence is a factor which appears to be growing, like that of the consumer's appetite.

In the developed world food is seemingly in such abundance that when the consumer orders a casual breakfast at their local café, or organizes meals for a work function, they may not often stop to think about the role their RFSO is playing in the CFS.

Figures from the hospitality sectors main association, Restaurant and Catering Australia, report the catering sector (including restaurants and cafes) is the largest contributor to the Australian tourism (visitor) economy; employing almost 530,000 people across 35,900 businesses (R&CA, 2014). The report also mentions the majority of these food businesses fall under the small category, with 93% employing 19 people or less, which bring about their own challenges including the low likelihood and a lack of opportunity to receive appropriate on-the-job or on-going training (Dawe and Nguyen (2007). The RFSO offer a variety of employment positions that can range from an un-skilled kitchenhand or banquets food runner through to a trained and skilled general manager or executive chef. The decisions and actions of these various types of employees influence the environmental performance of an RFSO as a whole.

The food service sector in Australia however is reporting a shortfall of skilled workers with data from Deloitte on the Australian Labour Force Report 2015 – 2020 stating 71% of café and restaurant businesses in this sector are experiencing recruitment deficiencies and will require an additional 123,000 workers by 2020 (Deloitte, 2015). The CEO of Restaurant and Catering Australia John Hart supports these projections, stating the food service sector will require almost 44,000 more jobs by November 2018 due to growth of around 8.5% being higher than any other sector in the Australian economy (Wylde, 2015).
These staff shortages may be compounded when research indicates more people are eating away from home. Data from Australia's largest dining reservations company Dimmi, suggests the local restaurant industry in Australia grew 4.4% from the previous

year (Dimmi, 2016). US research also confirm the growing trend towards more people eating meals away from home. Data from Morrison (2013) suggest that for the first time the spend on meals eaten away from home has eclipsed the spend on meals at home (as can be seen in figure 8). Although the average spending at restaurants has fallen by 9% around the globe in the last four years, spending on fast food has increased by 23% in the same timeframe (Comm, 2015).

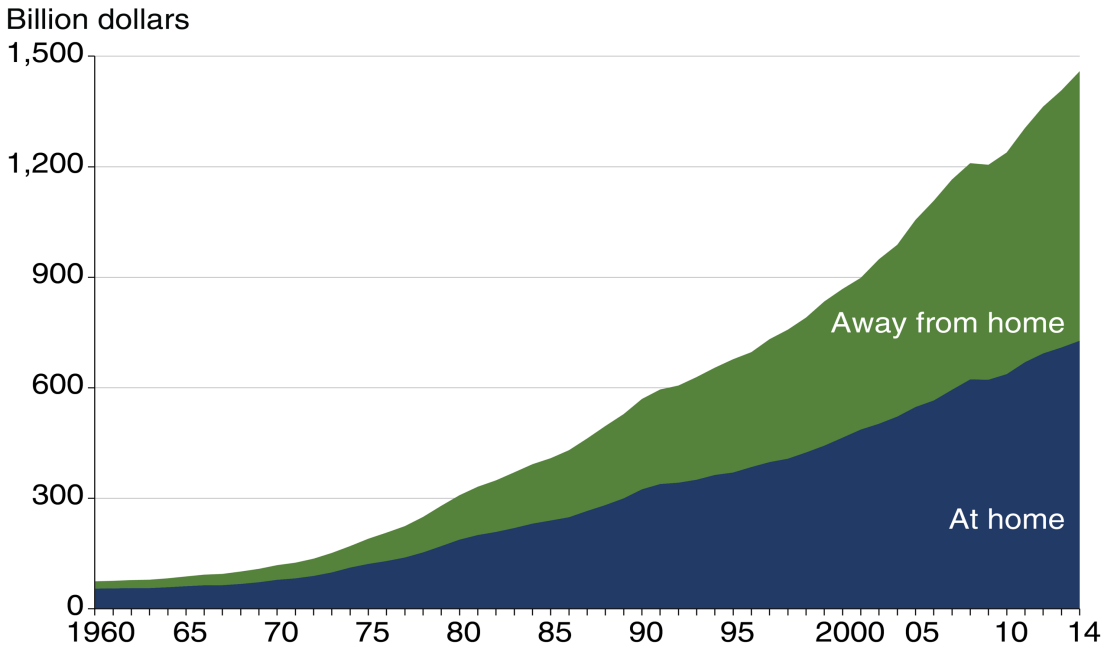


Figure 8. Food-at-home and away-from-home expenditures, United States, 1960-2014; USDA Economic Research Services, Food Expenditure Series,

As the trend of dining out potential continues to increase, and the RFSO sector continues to grow in turnover and staff employed, so does the demand by the consumers. Understanding these trends are important in planning for RFSO as it may translate as opportunities or challenges for the CFS. RFSO can have a variety of inputs that include the basic resources required to operate most businesses; energy for lights, heating, cooling and water for cleaning/sanitation and drinking. However, unlike the traditional retail service type business the RFSO must also consider energy for chilled storage, and heat and water for cooking. In addition the RFSO is also inherently dependent on the CFS and its consumption of resources.

In an attempt to differentiate the various impacts the RFSO food sector is having on the natural environment Davies and Konisky (2000) identified three stages to simplify the obvious streams impacting the system which are:

1. direct environmental impacts (referring to energy use, air & water emissions & solid waste generation),
2. upstream environmental impacts (referring to the influence RFSO have over their supply chains), and
3. downstream impacts (the linkages between operators in these industries and consumer behaviour).

While the biological system is essential as it pertains to primary production, economic and social systems also play highly relevant roles. The political system however, may contribute the greatest influence of all due to international trade and globalization of the CFS. While policy, trade agreements, taxes and tariffs are all important factors of the CFS and the growing influence of the global corporations may suggest greater acknowledgment of their role is required (Clapp and Fuchs, 2009; Lang and Heasman, 2015) there are also other influences helping to mitigate the CFS environmental impacts.

Figure 9 displays the consumer and RFSO sector at the end of the production line influenced by the economic, political and social systems.

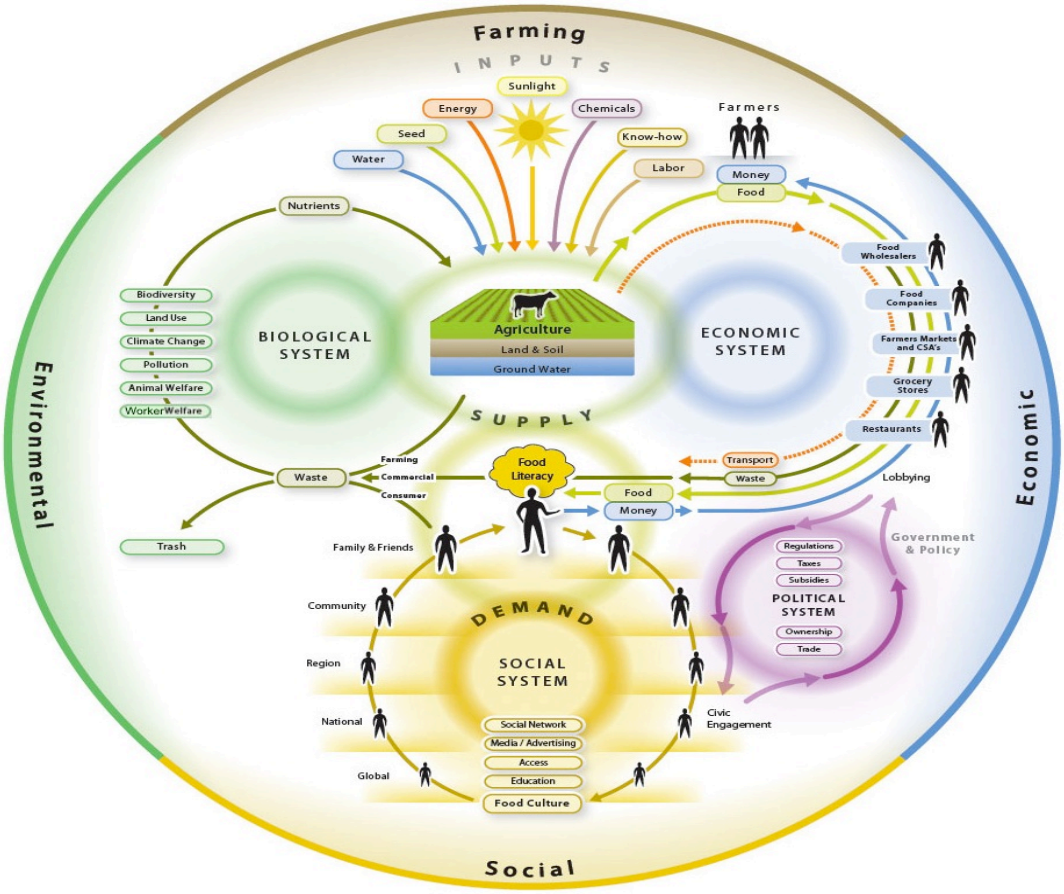


Figure 9. Nourish Food System, Circles within circles; Nickel-Kailing 2012.

2.3.2 Defining Sustainability in the RFSO

The term mitigation in this review is used in the instance of environmental impact, or more specifically recognising strategies that lessen the environmental impact of the RFSO sector. To understand the relevance of this enquiry this thesis will show one of the challenges facing the RFSO industry is their understanding or agreement on the meaning of the word, sustainability.

The World Commission on Environment and Development (WCED, 1987) has stated there is no universally agreed definition of sustainability and as such, it suffers from a number of contested definitions, meaning many things to many different people, which essentially can compromise its credibility (Santillo, et al. 2007). Agenda 21 was the set of sustainable development goals first formalized during the Rio Earth Summit in 1992 to aid in sustainable legislation and regulation, as well as to inspire to achieve a more efficient and equitable world economy (UN, 1992), and to be implemented at state and regional levels of governments as Local Agenda 21 (LA21).

Although there has been much debate on the success of LA21 it was faded out in 2015 to make way for the newly developed Sustainable Development Goals (SDGs), aimed at achieving 169 various targets across 17 SDG by 2030 (UN, 2015). Although only two years on there are reports suggesting corporate and government action has been limited. According to a global opportunity report on SDG in corporate business only 32% of CEO's surveyed were aware of the SDGs, of that 23% were planning a response, and only 5% mid-level managers aware of the companies SDG plans (Brackley, et al. 2017).

Current research seems to suggest the concept of sustainability in the hospitality industry provides an "interesting paradox" (Jones, et al., 2014). As it may be argued that on one hand the industry's main focus is the promotion of growth, rare products, consumption and luxury, and yet on the other hand promote their commitment to sustainability and the environment (Hiltonworldwide, 2017; Marriot, 2017; MGM, 2017). Yet, despite this obvious paradox and despite its size and huge economic relevance worldwide there remains minimal literature in the sector (Fusi, et al. 2016).

2.3.3 RFSO sustainability factors

In attempting to establish the link between sustainability of the RFSO and the CFS identifying the major inputs in this sector is essential. Food preparation is a major component of RFSOs therefore share similar resource inputs to the CFS, namely energy and water, yet is also reliant on the major output of the CFS, the food product. Similarly, like the CFS, attaining accurate feedback on the efficiency of these inputs has been challenging owing to the lack of agreed measuring tools in the industry.

2.3.3.1 Energy

Any food production system requires energy input, and the consideration of the energy input required to provide the actual food resources for a meal is important, but not often systematically incorporated into decision making by the RFSO, or indeed by the consumer. While research both locally and abroad shows excess use of gas, water and electricity is common in RFSOs (Ma and Ghiselli, 2016; Mudie, et al. 2016; Wang, et al. 2013) there are very few obvious external programs to lessen consumption.
Wang et al. (2013) suggest the restaurant industry is seen as one of the least sustainable economic sectors in the world, with a UK study supporting this with evidence electricity consumption could be reduced by as much as 40-70% in commercial kitchens by improving user behaviour such as turning equipment off when not in use and re-arranging stock levels in fridges to allow better flow (Mudie, et al. 2016).

Although research in this area is fairly new there is evidence suggesting the theme of excess resource usage and waste is not a recent happening. A 2004 study on cleaner production in food service businesses in Queensland identified excess water and energy waste in every outlet participating in the study (Prasad, et al. 2004). Separate studies suggest that commercial kitchens are some of the greatest users of gas, electricity and water of any commercial sector and can often use up to ten times (10x) the energy of the average commercial building (Mudie, et al. 2013). Further research in this area also suggest that previous industry published estimates on energy consumption in commercial kitchens are significantly underestimated by up to 40% in kitchen cooking equipment and up to 22% in kitchen refrigeration (Mudie, et al. 2016).

Electricity

Electricity is an integral part of food operations in any developed country, and in Australia and other developed countries, it is relied upon to power many of the kitchen appliances including refrigeration, lighting, freezing, food processors and air conditioning. Although some large food venues are not serving meals every day, or in the instance of a football stadium or racetrack only once a week, the energy required to keep the freezers and cool-rooms operational all year can make a substantial contribution to energy use.

In the CFS electricity is used in a range of mechanical operations which includes automated machines used in food processing, caning product, steam cleaning abattoirs and automatic packaging processes. In the RFSO sector, electricity is becoming the preferred energy in large venues because of greater accuracy offered in temperature control, greater efficiency in power transmission and risk reduction due to potential risk from fire and open flames. Although large food and processing plants use energy efficient equipment to minimize energy waste, due to costs and scale these mechanized advancements are yet to flow into the RFSO sector. According to a UK study improving behavioural factors (including training and education) can save up to 70% of electricity usage in commercial kitchens and better maintenance of machines and equipment can save up to 45% (Mudie, et al. 2016).

Gas

Gas has been the most common energy source for commercial kitchens globally for the last 60 years, however it has been losing market dominance to electricity in the last decade. In 2013-14, Natural gas represented 22 percent (1,412.5pj) of the total energy required for electricity generation and a major source of energy for industry, exceeding black coal (1,248.4pj) for energy consumption for this purpose in Australia (OCE, 2016). Although natural gas has been promoted by the energy industry as a cleaner alternative to coal the discussion is now on its sustainability due to environmental impacts. Up until the early 1990s conventional gas was the main gas used in Queensland (DERM, 2016, Towler, et al. 2016), although it is still the main gas used in Western Australia which is likely due to the fact around 92% of Australia's conventional gas resources are located off the North-West coast (Leather, et al. 2013). This conventional gas supply has now been added to by natural gas extracted from coal seams (coal seam gas or CSG).

Traditional natural gas sourced from reservoirs found in sandstone formations and traditionally capped by impermeable rock (Elgas, 2016) has the same combustion properties as CSG, however is less geological intrusive as it can move to the surface without having to be fractured from coal deposits and pumped using water and chemicals (Navi, et al. 2015). An estimated 90% of CSG reserves in the country are found on East Coast of Australia, in Queensland's Surat and Bowen Basins, with the remainder in New South Wales (Leather, et al. 2013). The Surat basin, one of Australia's top two locations for coal seam gas (CSG) extraction, is also home to five major inland catchment areas which also support a number of important wetlands and rivers (QDIP, 2010). Due to the large amount of fresh water required in extracting the CSG there is currently much debate regarding the destructive impacts of the used water for irrigation and the potential impacts on underground aquifers and water tables (Hamawand, 2013).

In Australia gas as a liquid form can be offered in the either liquid petroleum gas (LPG) or liquid natural gas (LNG). The main differences being natural gas or LNG is a raw product which is methane based and LPG is a by-product of gas and petroleum refining. In the RFSO sector LNG is now becoming the main gas used in a range of cooking appliances from stove tops, burners and ovens through to hot water systems, however LPG is still the main gas used for portable gas bottles making it the choice for consumers with mobile units or remote locations.

Food

Food is obviously the main point of interest in a RFSO, although too often its origin, health, social and environmental impacts may not be a consideration. Menus are typically designed to attract customers and many RFSO's use price and well recognized food products or brands to achieve this (Antun and Gustafson, 2005). Understandably menus are developed to fit within budget constraints, and in commercial reasoning, it may sometimes be the price difference between a product of lesser quality versus the alternative "ethically sourced" or "enviro-friendly" product which becomes too expensive to support from a commercial perspective.

Although supply and demand are the cornerstone of any market based activity, the traditional food system is heavily reliant on ecosystem goods and services which can

include; weather seasons, rain, sun and biological processes. This style of food system has many natural and varying inputs requiring skill, time and labour to manage successfully.

It can be reasoned the CFS has enabled RFSOs to have endless seasons in relation to purchasing fresh produce year-round, however due to Australia's geographical remoteness in relation the other continents food sources, it many ways it has had to develop its own food sufficiency.

According to the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) census from the period 2011-2012 the most common foods[5] eaten daily in Australia by percentage of population were:

- 90% - a form of cereal or cereal product,
- 85% - a form of dairy or milk dish,
- 69% - a form of meat or fish, and
- 90% had a form of coffee or tea.

Australia can be perceived as a land of beef and wheat due to these being the dominant agricultural exports of the country valued at $13 billion and $6.17 billion (ABS, 2016). Although it's the third largest producer of beef cattle in the world (Behrendt and Weeks, 2017) it accounts for only 12.1 percent of global exports (ABARES, 2012).

Wheat

According to the same study by ABARES bread is the most common food eaten in Australia, concerning when a study by Uddin et al. (2015) indicates Australia's grain crop consumption is unsustainable. Extended droughts and challenges in up-stream water catchments have required innovation to adapt to these sometimes extreme conditions. In 2010 a group of farmers, scientists, researchers and breeders dubbed the 'Australian wheat warriors' were recognized for their contribution to global food security through their success with various wheat varieties by the International Maize and Wheat Improvement Centre (Farmweekly, 2010). Learning to actively adapt to the environment has seen wheat yields continue to grow. In 2000 Australia grew a world record wheat crop of 24.9 million tonnes (mt), yet this record has again been broken in

[5] Although it may be argued peoples eating habits may change slightly when they eat out at a RFSO these results form a basis for considering the issue of environmental impacts from the CFS.

2016/2017 with a crop estimate of 32.6mt (ABARES, 2016). The trend in Australia is also reflected in global trends.

Wheat is the third largest crop produced in the world (Ray, et al. 2013), and projections suggesting for Australia to be competitive in the export market it needed to double its wheat yields to achieve 2050 targets (Linehan, et al. 2012). However, climate change poses a substantial risk to yields. In Australia wheat production is the dominant user of land for crop production accounting for 55 percent of land in crop production (ABARES, 2012).

Crop projections and modelling are an important tool in assessing food security prospects (Challinor, et al. 2014). Asseng et al (2011) suggest heat stress from increased temperature associated with climate change can lead to greater losses than previously modelled. This may be concerning as a more recent study by Asseng et al (2015) now confirm previous projections of a 6% fall in global wheat production for every 1-degree Celsius increase in temperature. These studies do not take into account other impacts from climate change including severe weather patterns and extreme storms.

Beef

Beef is the most commonly eaten red meat in Australia and is given the largest share of the home food budget allocated to meat at 44% (Wong, et al, 2013) and the average annual consumption of beef per person has consistently averaged around 40 kg for the last 50 years (ABARES, 2014). Australia's population in 1945 was roughly 8 million people and in the last sixty years this has more than tripled to our current population of 24 million (ABS, 2014, ABS, 2015). Therefore it's fair to reason if beef production were to triple the resources required to produce the beef could also be required to triple.

According to De Vries and De Boer (2010) beef production uses the most land and energy out of all the livestock animals, is also linked to a variety of environmental damages including greenhouse gas emissions (GHGE), biodiversity loss associated with land clearing and freshwater contamination through mismanagement of waste, fertilizers and pesticides (Subak, 1999). Land clearing and intensive agriculture practices in riparian zones can have downstream impacts on river systems and coastal areas, and this can extend to coral reefs (Altieri, et al. 2017; Davis, et al. 2017).

Current estimates suggest the global average water footprint per calorie of beef is 20 times larger than for cereals and starchy roots (Mekonnen and Hoestra, 2012), and it is predicted that by 2030, in Northern Australia, the changing climate may have noticeable detrimental effects on biodiversity, pasture growth and water availability, such as increased pest lifecycles, prolonged extreme weather and more severe weather events, which may result in decreased production of beef (Cobon, et al. 2009). Although it may seem beef production only has negative consequences, in large parts of Northern Australia cattle graze on land deemed unsuitable for any other current economic purpose. In similar instances around the globe cattle are responsible for converting plant matter indigestible to humans into protein (Gerber, et al., 2015), essentially turning plant material (e.g. grasses) unsuitable for human consumption into food (beef).

2.3.4 RFSO externalities

An important yet often neglected factor in addressing environmental mitigation and sustainability performance in the RFSO sector is its externalities or waste streams. As figure 10 suggest perceived waste may be best managed in the first instance with prevention and disposal as a last option.

Although there is a variety of different ways the RFSO can reduce its impact on the environment, according to Baldwin et el (2011) on developing a LCA of the restaurant and food service in the United States up to 95% of the total environmental impacts could be attributed to food procurement.

From planning, construction, operation and demolition RFSO have a similar environmental footprint to many other commercial businesses, in the sense that many of the day-to-day resource consumption patterns are similar. However, due to the nature of value adding to a perishable product, which in some instances may have been transported many thousands of kilometres, the gas, liquid and solid waste are externalities that a standard business may not have made taken into account. Exhaust fumes from cooking proteins, cooking oils and cleaning chemicals and multi-material packaging can all play a significant role in the RFSO outputs.

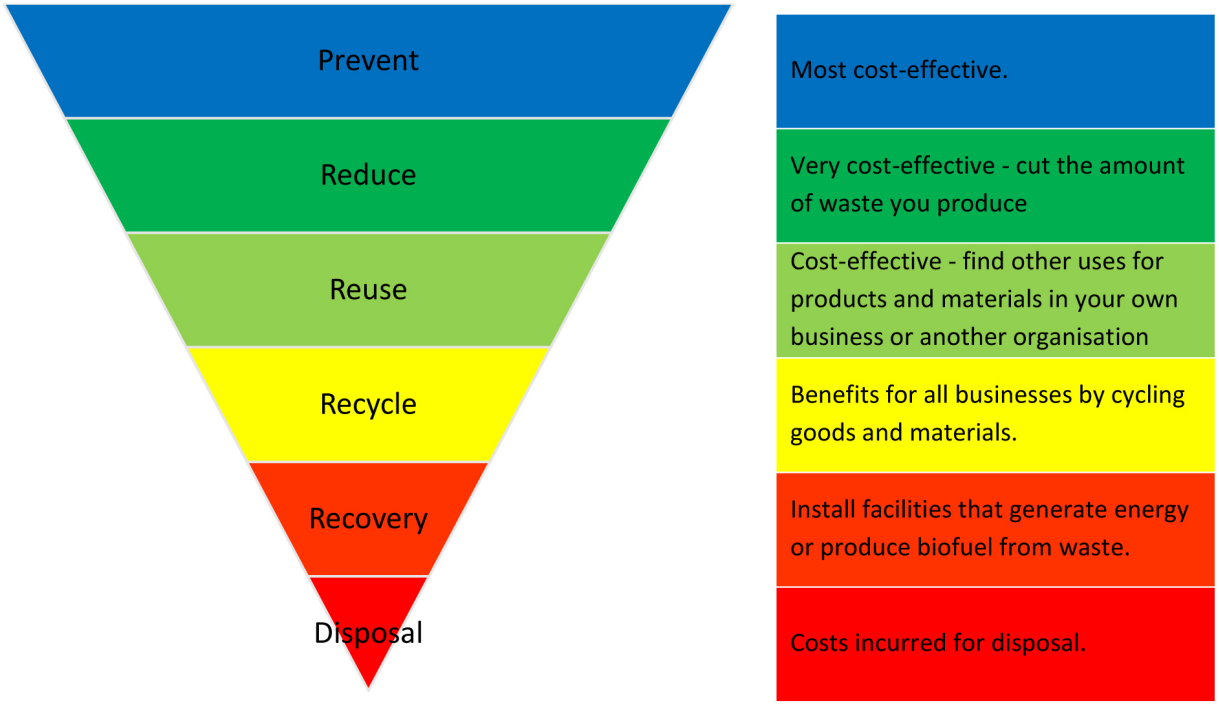


Figure 10. Waste hierarchy, Prevent, Reduce, re-use, recycle; Rejuven8 Repairs 2017.

But perhaps the greatest challenge is food waste (Godfray, et al 2010; Kumma, et al. 2012), and this area currently has the least amount of accurate data (Fusi, et al. 2016; Marthinsen et al. 2012).

Resource waste is recognised by some as hospitality's most noticeable environmental effect (Bohdanowicz, 2005) and a growing problem in the RFSO that is largely reducible (Pirani and Arafat, 2016), however there seem to be some practical challenges in addressing this (Jones, et al. 2016; Ma and Ghiselli, 2016). According to the Green Restaurant Association, the main association responsible for encouraging sustainable hospitality practices in the United States, close to 95% of the waste produced by an average restaurant could be re-appropriated through either recycling, composting of or other re-valuing methods (GRA, 2013).

2.3.4.1 Food waste and loss

Although there is literature suggesting excess food is being produced throughout the CFS (Pretty, 2011), more attention may need to be on the wastage of food (Arvanitoyannis, 2008; Parfitt, et al. 2010,) and ways to combat this problem. Current figures estimate up to 30 percent of all food produced globally is lost or wasted (FAO, 2015) and this can be due to lack of infrastructure in the supply chain in developing countries or the wastage by retailers and consumers in the developed world

(Gustavsson, et al. 2011). One study states that during the period 1996 – 2015 the population of Australia grew by 28%, however in that same period the waste generation increased by 170% (Ritchie, 2016).

Figures from the Green Restaurant Association (GRA), the main organisation in the United States responsible for environmental guidelines and data collection in the RFSO sector estimate up to 95 percent of waste produced by a restaurant can be either recycled or composted (GRA, 2013). In China the increasing problem of food waste is costing $US32Billion per year and has been projected the wasted food could feed another 200 Million people (Zhou, 2013). According to a study on waste in 2009 the United States recovered and recycled less than 3% of the 34 million tonnes of food waste generated that year (Kosseva, 2013), and an Australian government fact sheet from 2013 suggests that 37% of waste from RFSO is specifically attributed to food waste, with another 50% of total generation likely to contain food waste as well (Encycle, 2013).

In the RFSO sector traditionally a light bin or minimum wastage represented a good chef, someone who monitored and managed produce effectively and efficiently. A heavy bin or excess waste therefore has traditionally had negative connotations and this may be one reason why accurate food waste figures are extremely hard to gather. There is personal reputation invested in it. Spencer and Kneebone (2007) found that apart from the dairy industry, the RFSO sector is extremely diverse and poorly serviced with information. Morgan (2009) suggests this may be due a failure by different segments of the food production and consumption cycle to recognize the need for greater communication.

In Queensland in 2013 it was estimated over 41,000 tonnes of waste was generated from food processing (EHP, 2014) and 50-80% of trade waste in South East Qld is generated by the food industry (Prasad, et al. 2004), yet although the research identifies challenges in food waste within the RFSO sector, there are seemingly no recognised industry wide mitigation strategies adapted to combat this.
Furthermore, it may also be noted that the economic cost of resources essential to produce this food are on the rise. In the United States food waste has risen 50% in 40

years, accounting for the wasting of over 300 Million barrels of oil and 25% of total freshwater consumption per year (Hall, et al. 2009).

2.3.3.2 Water

Indirectly, food on the menu is indirectly linked to the world's freshwater supply. In addition to the use of water in the production of food which has been discussed previously, various stages in the food transport and preparation process require water as either a solvent or cleaner which then after its initial use become tainted and another output. Examples of common practices can include; 1) the washing of salad greens and fruit before consumption in an attempt to dilute any chemical or transport residues; 2) the cooking of starches and vegetables in large pots or brat pans; 3) regularly cleaning all surfaces and equipment used in the cooking process; and 4) the leaving of frozen produce in sinks whilst water runs freely over it in an attempt to fast track the thawing process. The latter may in some cases may constitute a breach of health regulations in some jurisdictions, but in the author's experience it remains a common and accepted practice. Some other common uses include; washing waste down sinks and toilets and washing transport vehicles and storage facilities. Although this water may only be used for cleaning and cooking purposes it is the lack of recycling methods adopted in the RFSO which may add to excess usage.

Water consumption in the RFSO may not gain the same attention as energy however Dziegielewski (2000) found that water use in RFSO accounts for approximately 15 percent (15%) of total water use from all commercial and institutional facilities in the United States. In addition, a study by the University of Queensland on a sample of medium sized food service business in Brisbane, suggest an annual fresh water use of 2,200kl (UNEP, 2005). Although quantity varies with different types of cuisine it is an essential base for many stocks and sauces on the menu around the globe. While these uses may seem insignificant on face value, cumulatively they may be important, although the data gaps preclude rigorous quantification.

2.3.3.3 Packaging

Although maybe not often thought about when ordering product for RFSO the packaging can play an important part in environmental impact. Food packaging can provide protection from three major forms of external influence: chemical, biological and physical (Marsh and Bugusu, 2007). Packaging is an important part of the relationship between the CFS and the RFSO sector and due to advancements in technology and synthetic processes; manufacturers are using more multifunctional materials to package food (Lagaro, 2011). Current packaging may contain a combination of materials including; plastics, papers, cardboards, metals or glass (Marsh and Bugusu, 2007) and advancements in nano-food packaging (Bumbudsanpharoke and Ko, 2015; Duncan, 2011) may mean even more single use material.

In many instances the produce needs to be transported in a hygienic and efficient manner to protect it from contamination & damage and packaging assists in this. Temperature regulation and strength, as well as providing an efficient and uniformed size to assist in the cost of transport also helped shaped the development of newer and more multi-material packaging solutions. Initially some of these packaging advances may seem an ideal solution for food producers and consumers alike, however many of the materials used are a combination of compounds that are difficult to recycle (Tolinski, 2012), leading to increasing environmental challenges when attempting to dispose of. However, advancements in plant based polymer materials may prove successful in the new generation of packaging (Rhim, et al. 2013; Tang, et al. 2012), and research now suggest that the consumer may prefer packaging from more natural products (Muratore and Zarbà, 2011), and it is the consumer that controls the market.

2.3.3.4 Food miles

Food miles is the term used to represent the distance that products travel from their original location to the consumer. Although there is some concern that the method is potentially misleading as it does not take into account other environmental impacts of food production (Rama and Lawrence, 2008), it is a useful tool in recognizing the products origin (Kissinger, 2012) as well as measuring the carbon emissions from the transport vehicles.

Consumers have become accustomed to being offered a variety of foods out of season, and due to the globalization of the food system and a greater dominance by global corporations, food miles may seem to be an obvious identifying factor of the CFS, however research suggests it is not an issue consumers are too concerned with (Kemp, et al. 2010; Sirieix, et al. 2008). In a 2001 study in the United States the 30 most popular fruit and vegetable were measured for their distance travelled. The data identified the top 5 products travelled over 2000 miles (or 3,218km) to get from grower to consumer (Pirog and Van Pelt, 2002).

In the instance of Australia, due to its remote location in relation to the rest of the world, food miles can be more extensive. As an example asparagus is a common item on dining menu's, however in many instances the product comes from Peru, currently the leading exporter of fresh asparagus on the planet (Azimi, 2012). The direct distance from Peru to Australia's largest city Sydney, is over 12,400km, yet this doesn't take into account variations in road, rail and flight routes. In a similar scenario Brazil is the second largest pork producer in the world, and Australia imports 80% of its pork product, yet the direct distance from Brazil to Sydney is over 14,000km. Once again this distance doesn't take into account the local market collection and distribution channels at each end. With the current growing culinary trends leaning towards food provenance and local/ regional products (Technomic, 2015) it may be the topic of food hours (the measured time between harvest and customer) that holds more relevance.

Fresh food requires processing, packaging, storage and transport, and depending on the processing steps and product perishability refrigerated storage is required, all which demand energy from the finite source of fossil fuels. Fortunately there are businesses attempting to create transparency in this space. One such company, in the United Kingdom, in an effort to promote local producers and educate consumers on the food miles of various products, have devised an interactive website that calculates the distance various food products travel (Foodmiles, 2016). This may be more relevant for RFSO decision makers enabling greater control over their menu planning and kitchen sustainability management programs.

2.4 Current approaches to encourage accountability in sustainability

The largest environmental impactor in the RFSOs is the CFS, and its reliance on finite resources mean new approaches are needed to manage these growing challenges.
To help reduce the impact on the natural environment there are some recognised environmental mitigation strategies in operation. Typically, the main strategies available are applied through government regulations, corporately recognised frameworks and/or commercially driven incentives.
Eco-labelling, Life-cycle assessment (LCA) and International Standards Organization (ISO) are some of the more well-known strategies credited with giving business and consumers greater guidelines and information on a products environmental impact. Safety, quality and efficiency of food products around the globe, including Hazard Analysis Critical Control Point (HACCP) and the Global Food Safety Initiative (GFSI) often use guidelines set out by the FAO and WHO in the Codex Alimentarius Food Standards (FAO, 2016), yet there is extremely limited globally accepted schemes attempting to mitigate the environmental effects food products and the RFSO are having on the environment.

There are currently several sustainability ratings tools for commercial buildings to develop greater efficiencies in the energy and resources criteria, however perhaps the most widely used green building certifications scheme for commercial building design and construction is the Leadership in Energy and Environmental Design (LEED) certification which is involved in nearly 80,000 projects across 162 countries (Shutters and Tufts, 2016). Although the LEED program, developed by the United States Green Building Council, has a widely recognized reach the Australian government has a similar program, National Australian Built Environment Rating (NABERS), operating from the same time, originally designed as a ratings system for energy and green house efficiency (Bannister, 2012). Similar to the LEED program, it has evolved to include a variety of measurements including: water efficiency, advanced energy metering, life-cycle impact reduction, indoor and outdoor air quality and innovation (LEED, 2017; NABERS, 2017). Although a study by Walsman and others (2014) suggested superior financial performance of LEED certified hotels against their counterparts for the first two years of certification, there was insufficient data to make conclusions.

2.4.1 Eco-labelling

Eco labels (EL), also known as green labels, eco certification or ethical certification, are a form of mitigation strategy adopted by industries supporting the claim that a product has a particular environmental property and feature (de Boer, 2003). It is believed one of the main aims of ecolabels is to encourage consumer trust and support throughout the supply chain, and this result may be crucial in guiding production paths towards environmental performance (Leonidou, et al. 2011).

Eco-labels have a range of impacts, one being to encourage consumer recognition for the businesses environmental claims. Although one of the primary driving forces for companies behind these labels may be the increased market dollar spent by the consumer (Demarque, et al. 2015; Vlaeminck, et al. 2014; Mason, 2006), the increased environmental awareness of the end consumer can be construed as a positive externality.

Eco-labelling is not a new concept. Germany's Blue Angel, which established its ecolabel brand in 1978 and covers almost 10, 000 brands (Ecospecifier, 2017). In the last decade however there is increased exposure of ecolabels in marketing. According to the world's largest ecolabel databank, Ecolabel Index, in 2017 there were 465 ecolabels representing business in 199 countries, across 25 industry sectors, including 59 different labels in the food industry (Ecolabelindex, 2015).

Ecolabels can be broadly classified as follows:

- First party: Also referred to as self-declaration by individual companies, may be used to inform consumers on specific environmental issues and unregulated by independent third parties. Claims may lack the support of reliable scientific evidence. Some include: the recycle symbol, green ticks, naturally raised, local or stamps/imagery promoting 100% natural.

- Second party: Commonly established by industry or special interest groups involving elaborate certification criteria. Verification of compliance is achieved through internal certification procedures or external confirmation

of claims. Some of these may include: Free range, organic certified, Food Alliance, cage free.

• Third party: Commonly established by independent third partys' are typically an organization which specializes in environmental audits. They encourage transparency of the 'chain of custody' and may promote themselves as the environmental educators. Some of these may include: MSC (marine and stewardship council), Dolphin Safe, RSPCA approved.

2.4.1.1 RFSOs and food related ecolabels

While there are a variety of eco-labels in Australia across a range of sectors relevance of ecolabels below are some relevant to the CFS and RFSO.

Brand	**Products**	**Type**
Australian Certified Organic	Incorporates all food products	Third party
Australian Southern Rock lobster	Lobster	Second party
Bio-Suisse	Large range of food products	Second party
Blue Angel	Active in all building materials, + (Worlds 1st enviro label)	Third party
Dolphin Safe	Tuna	Second party
Free range	Chicken and chicken products	Second party
Global Green Tag	Active in all building materials	Second party
Green Tick	Active in all building materials	Second party
Marine Stewardship Council (MSC)	Seafood and seafood products	Third party
Rainforest Alliance	Banana, cocoa, coffee, palm oil & tea	Third party
RSPCA approved	Include chickens, pigs, turkeys and eggs	Third party
100% Natural	Food products	First party

Figure 11. Table of eco-labels relevant to RFSO in Australia.

Although there is a growing list of identifiable eco-labels for consumers in the retail industry through branding and marketing of products, the wholesale arena is different altogether. Purchasing food and beverage in bulk affords the RFSO greater savings but these are invariably offset by things such as plainer packaging which may aim to save the producer money on printing and high gloss material.
High gloss informative packaging material promoting and reinforcing the ideals of ethical production may hold the attention of the retail consumer, however wholesale packaging is vastly different, often sold in plain cardboard boxes, bulk wrapped, with little more than a brand. In many cases the person in charge (PIC) of procurement is employed in the business as a chef, manager or purchasing officer, and as in many sale of goods and services, wage incentives are many times an accepted part of the bonus agreement.
Similar to other sales incentives in RFSOs it has been industry norm for part of the salary agreement to include a bonus scheme on reducing the money spent on food in relation to the amount sold. Due to this economic rule adopted by many RFSO, price point is the difference in purchasing goods, therefore a more expensive ecofriendly and sustainable product may not fare as well as their cheaper counterparts.

Just how much attention do consumers play to eco-labelling is a topic of much commercial interest. Although research may be encouraging for marketers regarding the influence eco-labelling and ecofriendly products have on retail consumers and the environmental impacts (Grunert, et al. 2014; Ibanez and Grolleau, 2008), as well as the significant role they may play in increasing consumers behavioural control (Testa, et al. 2015) there is still extremely limited studies into any influence these may have on RFSO Research by Witek (2017) on the impacts of eco-labelling on consumer behaviour believe overall consumers have positive attitudes in relation to eco-labelling, however green products are seen as an item only the rich can afford.

There are also concerns being raised on the credibility and impact of certain ecolabels due to the variety and amount of different ecolabels flooding the market (Nilsson, et al, 2003) with studies concluding that consumer trust is the most relevant factor when dealing with ‘green’ products (Nuttavuthisit and Thøgersen, 2017; Ricci, et al. 2018).

From the primary producer to the consumer it may be reasonable to suggest the real role of eco-labelling can only be guaranteed with adequate accountability and best practice techniques throughout the supply chain (Styles, et al. 2012).

2.4.2 International Standards Organization (ISO) Guidelines

Due to the many influences in the supply chain of the RFSO there is not yet a globally recognized label that successfully encompasses all areas of a products life cycle. The international Standards Organization (ISO) offers guidelines and frameworks that enable the user to assess and manage their operation using internationally recognised standards for that particular sector or industry family. For example, the ISO 14040 is from the environmental management suite and offers the consumer the principles and framework required to measure their operation using a lifecycle analysis (LCA) approach against the internationally accredited criteria accepted as an industry standard (Guinée, 2002), just as ISO22000 is a certification scheme to recognize food safety in the Agriculture and Food sector.

The standards act as guidelines for business with recognised third party auditing assessments and enabling them to attain an ISO certification (ADE, 2014). Apart from assisting compliance with legislation and preventing environmental risks the suite of ISO14000 certifications can also improve company image and encourage efficient use of natural resources (Boiral, et al. 2017; Santos, et al. 2016).
Some ecolabels in the green category use the guidelines of ISO14001; Environmental Management Systems (EMS) to develop standards to represent their label, however this can only really be effective if all the actors in the supply chain or cycle are working within the same parameters (Xu and Gursoy, 2015).

Cost associated with implementing ISO certification can be significant and can include; external consultant to develop documentation, internal resources, pre-certification audit, the main certification audit, surveillance audits, and a complete company commitment to the process including marketing and promoting of the awareness of the environmental implications (Yiridoe and Marett, 2004). Research on the registration and implementation costs of ISO14001, suggested cost of the program to be prohibitive and outside the budget of small to medium enterprises (Johannsson, 1997), and that

chances were "low" or "unlikely" for uptake for up to 97% of Canadian businesses (Yiridoe and Marett, 2004). Worth noting is that small to medium enterprises make up an estimated 90% of the world's economic activity therefore due to the high cost of ISO certification the appeal may mostly be to large multinational and global organizations (Van der Veldt, 1997). In Australia small to medium enterprises make up the majority of the 45,000 RFSOs businesses operating. Therefore, although these standards may be globally recognised by many governments and corporations the financial cost and difficulties of certification and auditing may mean many small businesses cannot afford the certification process and miss out on trade opportunities.

2.4.3 Life Cycle Assessment (LCA)

LCA is a method for assessing a product's environmental impacts throughout its entire lifecycle, and includes all resources consumed, wastes generated and emissions to the environment (Renouf and Allsopp, 2013). Although the cost of an LCA on products can make this form of labelling cost prohibitive for many small businesses, Berkhout and Howes (1997) suggest those willing to adopt this strategy are most likely to find opportunities for improvements in the life cycle and environmental performance of products, while also making gains in competitiveness.

In specific reference to the RFSO sector there are limited programs offering the LCA approach. In the United States, Green Seal, an organization offering environmental standards and certification across a platform of industry include restaurants and food services as a certification package (GS-55) which has been operational since 2009 (Bragonier, 2009). Green Seal originally set out to conduct an LCA of restaurant and food service operations, and after identifying the lack of supporting framework and guidelines developed their own sustainability and certification program (Baldwyn, et al. 2011). Even though feedback from industry suggest this style of program is an important step for the future of the sector, uptake by the RFSO industry has been slow, with the Green Seal site indicating the only RFSO certified so far are in Chicago, Illinois (Greenseal, 2017).

2.4.4 Environmental Management Systems (EMS)

Regarding the inputs to RFSO the EMS is a management tool that assists people to identify and assess environmental risk associated with their activities (Cary, et al. 2007) has potential to become a prominent tool for agriculture, to improve natural resource management and landscape management, as well as for businesses to demonstrate their clean green image to overseas customers (Carruthers, 2001). Although EMS can be used across most industries a customizable approach may be one of the better options for the RFSO and their supply chain, to reduce waste, and energy consumption, manage waste streams more effectively and even assist in building awareness among employees as the main framework consists of; plan, do, check and act (Hersey, 1998).
However, even though EMS may seem to offer sustainable benefits for all users, in a later study by Carruthers (2012_{pg682}) it was noted: due to inconsistent government policy, and insufficient industry support, the full potential of EMS to drive natural resource management change in Australian agriculture has not been achieved.

2.4.5 Food rescue

Industry associations can also provide information that encourage improvements in environmental performance, while individual enterprises may adopt approaches from a moral perspective, or in realization that an issue such as food waste is not only an environmental issue, but also one that may influence the bottom line of the enterprise. Food waste data in RFSO are difficult to determine, due to a variety of issues including; lack of collective representation within the hospitality industry and the catering professional's stigma towards food waste (Fusi, et al. 2016). Research shows the majority of waste stream data comes from food rescue businesses, so not only do these organisations play an important part in food re-cycling, they are also the main way in which regular and up-to-date food waste data from the consumer end is derived (Mason, et al. 2011).

Although food waste is a major issue in the CFS there are some businesses and organizations attempting to mitigate some of these effects though such procedures as rescuing, re-valuing and re-using food. Food rescue organizations concentrate on re-valuing, re-utilize and re-directing surplus food, and in many instances, they are the main supporters of the 3,000 not-for-profit food programs feeding 4-8% of the

population in Australia each year (Linderberg, et al. 2015). Predominately made up of non-for-profit and charitable organizations the basic businesses model is to rescue food that would otherwise be thrown away, and in-turn, re-cycle and re-use the salvageable products, and distribute them to organizations representing people in need. Whereas many of these organizations were founded to help feed the disadvantaged of the population, there is an increase in numbers from different levels of socio-economics looking to supplement their diet with rescued food (Lindberg, et al. 2014).

Foodbank, OzHarvest and Second Bite are three of the main organization's operating in Australia attempting to utilize food that would otherwise be wasted and sent to landfill (Foodwise, 2016). Foodbank Australia is Australia's largest food relief organization, with their annual hunger report claiming to have served over 60 million meals in the year 2015-2016, an average 166,000 meals a day from rescued and reclaimed food (Foodbank, 2016). Originally founded in the United States in 1967 it has been established in Australia since 1992 and is the major supplier of food to the Emergency Relief sector (Benjamin and Farmar-Bowers, 2013). Foodbanks operations focus on the contributions of big business and corporations to manage bulk surplus from large food producers, manufacturers and wholesalers, as their business model is not designed to manage the smaller amounts of food from the day-to-day excess of RFSOs.

OzHarvest, initially focused on the excess food from the RFSO sector, self-reports it has managed to feed on average over 10,000 meals per day (OzHarvest, 2016). OzHarvest have gained global exposure through multiple streams of media, using celebrity chefs, food professionals and social campaigns to raise awareness on the issues of food waste, social problems and the impacts various diets can have on the environment (OzHarvest, 2015). Similarly, SecondBite, established the same time as OzHarvest (2005) distributes excess food; also offer nutrition programs for the food insecure. They are also corporately partnered with Coles supermarkets for fresh food donations (Secondbite, 2017).

Food rescue organizations have only developed since the inception of the agro-industrial food system yet play important roles in re-using food and collecting difficult to access food waste data, although the accuracy of this data has been challenged due to lack of evidence to evaluate or support claims (Linderberg, et al. 2015). Adding to the

lack of empirical research is the scepticism that the food rescue sector may assist economic efficiency in the modern food supply chain, through savings of storage, transport and landfill charges, enabling waste from food from large food businesses and supermarkets to be written off as a taxable donation instead of a loss (Booth and Whelan, 2014). Major sponsorship deals between Australia's supermarket duopoly and the three largest food rescue organization only strengthen this scepticism (FoodBank, 2017, OzHarvest, 2017, Secondbite, 2017).

2.4.6 Composting

Composting of organic waste, although an essential cycle in nature, is not common practice in an industry responsible for discarding up to 60% of all waste as compostable (RCA, 2017). Many RFSO do not have gardens or access to them therefore it may be reasoned composting organic waste is not always possible. However, recent advancements in technology have supported the development of in-vessel composting machines which can breakdown hundreds of kilograms of organic waste within a short timeframe, essentially reducing the initial product by up-to 90% (Bonhotal, et al. 2011). A Melbourne based restaurant, Brothl utilized an advanced closed loop system for composting. It impressed several of the world's leading chefs through its ability to virtually eliminated smells and other issues related to garbage, who has since replicated this concept in their own restaurants (Kirby, 2015). However, commercially available composters current management may need to recognize the importance of council compliance before the closed loop system becomes mainstream. In 2015, the same sustainable style restaurant, Brothl, closed due to non-compliance with regulation relating to its property compost facility near the CBD. This example also highlights the regulatory environment and other competing interests that can stifle innovation in RFSOs, reducing their environmental performance and efforts to become more sustainable.

In 4 of the major cities in Australia, and more locally Brisbane city, small enterprises operate throughout the CBDs collecting the organic waste of RFSOs, transporting it to nearby farms, where in time it's turned into compost. The RFSO benefit from this service by getting herbs and seasonal leaf vegetables at a discounted price as well as reducing their general waste destined for landfill.

2.5 Sustainability Performance Indicators in RFSOs

Key Performance Indicators (KPI) are a common tool used to measure performance of specified objectives. Therefore as the name suggests Sustainability Performance Indicators (SPI) are a combination of variables used to measure pre-determined goals identified by the developer as significant in the sustainability of a particular area. Although currently used in a variety of industries including construction, manufacturing and farming (Husgafvel, et al. 2015; Mata-Lima, et al. 2016; Repar, et al. 2017) their use in RFSOs is not well documented. While no specific framework of SPI are widely accepted in the RFSO sector there are certain parameters and properties that are expected to feature including: *pertinence, reliability (i.e. scientifically sound), operationality (easy to estimate and update), legitimacy (accepted use, appropriation by stakeholders), interpretability (easy to understand and communicate), genericity (allowing comparison at various spatio-temporal scales), and defined in a finite interval (e.g. 1–5, A–D, etc.*). (Avadí and Fréon, 2015, pg 519).

SPI can be used to identify best sustainability practice as well as provide a set of benchmark tools most suited to the industries organizational profile (Mata-Lima, et al. 2016). SPI may also be used to manage the input and output streams of a RFSO as well as be used as a sustainability management tool.

2.5.1 Staff education and training

The RFSO sector fits under the umbrella of the tourism industry which covers other sub sectors including hospitality and travel. However, the RFSO sector is unique in that it not only provides a service it also supplies goods, which are often transformed from perishable products by a variety of skilled and semi-skilled staff, alluding to the importance of training and education in this sector.

Research shows staff education and training is fundamental in delivering strategic objectives in the tourism industry and has been proven to improve business competitiveness, enhance service quality, staff commitment and retention (Blake, et al. 2006; Eaglen, et al. 2000; Thomas and Long, 2001) yet on average the hospitality industry has the lowest educational achievement averages of any industry.

Contrary to some presumption that "those who feed the world" do so from high moral ground (Diebel, 2008) the role of the chef from a realistic perspective maybe vastly different than shown on television shows, which often fail to show the arduous hours and difficulty in sourcing and preparation behind the scenes. Palmer et al (2010) phrased the role more accurately when discussing professional chefs, identifying that being a chef is more than just a job, it is sacred work involving sacrifice and pain leaving a physical imprint on the individual in the form of burns, cuts and scalds.

In Australia the method of training a person to the position of trade qualified chef has been through an apprenticeship with eligibility for entrance traditionally requiring a minimum year 10 certificate or equivalent (TafeQld, 2016), however this was changed in 2013 by the government main training body, Industry Skills Council, which now does not require any entry requirements for this qualification (ISC, 2017).
The apprenticeship to attain a trade cookery certificate (which used to take 4 years) can now be completed between 12 months (WilliamAngliss, 2017) and 36 months (TAFEQLD, 2017) in Australia, which includes theory and practical lessons at a technical college and on-the-job training.

Although the entry requirements and duration of the apprenticeship has decreased within the last two decades, Australia is reported to have an international reputation for excellence of its tourism and hospitality training (Davidson, et al. 2011). A study on a UK catering college showed half the students who started the cookery course never work within the industry (Pratten, 2003). Further research suggests the majority of chefs who achieve a trade cookery certificate do not gain any further formal education apart from on-the-job experience. Complaints of high discipline, sexism, anti-social hours, poor pay and poor conditions of work are reason given for many who moved on from the kitchen (Pratten, 2003).

A common saying amongst kitchen staff in the hospitality industry is; it's the easiest profession to get into, but the hardest to get out of. This supported by the fact in many circumstances there are no opportunities for kitchen staff to up-skill or receive any formal training past their initial qualification (Bastola, 2013). The hospitality industry has one of the highest amount of part-time employees and staff turn-over out of any sector and a study by Watson (2008) found there were fewer opportunities for skill

enhancement in areas of part-time and under-employment. Other professions would continue on the job training with their employer, however due to lack of available time and resources, only one third of all small businesses provide any type of structured training for their employees in Australia (Dawe & Nguyen, 2007). Although difficulties arose when searching for recent figures research from Poulston (2008) suggests poor training is associated with high staff turnover and investment in training was highly recommended.

Adding to the challenges of attracting high skilled and educated staff to the RFSO is the range of convenience food products growing in the market place. Of particular interest and the cornerstone of many cuisines around the globe, is the basic brown stock. A stock is the base of many sauces, soups, curries and gravies, and traditionally the best way to it utilize all vegetable and meat scraps discarded throughout the process of food preparation. Essentially each stock uses a base of bones and meat and vegetable trimmings and any kitchen staple includes beef, chicken and fish. Once the essential foundation of traditional French cookery, the stock was a way to recycle food scraps into a sauce used for a variety of dishes and in many instances took days to prepare to reach the final 'jus' or juice stage. Due to the organic content the stock/jus has a limited lifespan and requires constant refrigerated storage.
Advancements in food technologies mean today's chef can purchase a basic brown beef stock, replicated to a powdered form as a shelf stable product, without the labour, energy and time. What traditionally was a foundation of French cookery, encouraging efficiency, re-cycling of organic waste, good food knowledge and technique, can now be brought in a tub (Nestleprofessional, 2017), or custom ordered to a specific taste (Boneroasters, 2017).

Traditionally the consumer ate what the menu offered, typically designed by the chef, however data from Technomic, one of the world's largest food service research companies, suggest that one of the greatest global food trends is customization of convenience foods (and the ability to choose multiple ingredients to individualise their meal) and their recent survey showed up to 51% of customers believed it created good value (Technomic, 2015). While this may seem a reasonable request to add to or change items on the existing menu, to ensure the customer gets their request, the operator of the RFSO must have a greater range of ingredients available on hand. However as

discussed, basic vocational training times and skill specific modules of chefs are reducing whilst a greater range of products are required to be available for the extended ingredients list, potentially translating to an increase trend of food waste around the globe.

Where before basic butchery was essential to know how to break down a large piece of meat, due to greater industrialization of the food system, a chef or PIC can now order any piece of meat, cut and weighed to any specification, in any quantity, and dependent on the amount, can receive this order the same day (MLA, 2016, Meatco, 2017). The same applies to many products once an essential part of the chef's repertoire.
What once used to be a profession that required a high level of skill over a broad range of topics, todays chef now have a huge range of conveniences at their disposal, short cutting the basic principle of cooking. The traditional French cuisine basic cookery methods have the fundamentals of waste minimization through innovation at their core.

Vegetable trimmings are a bi-product of vegetable preparation. For efficiency the peelings from the staple carrot, onion and potato were recycled back into the menu process in an effort to utilize all food. Today's fruit and vegetable suppliers offer all these services including pre-peeled and cut to any specification, any weight and any mix (Coastalfresh, 2017). Initially this may seem a highly effective way to operate an RFSO, using industrialized processors to streamline specific products and quantities, however this also means the traditional skill of recycling innovation is not of major concern and could impacting the valuation of the food by the chefs in the preparation and cooking phase.

Although some environmental impacts of the CFS, including ecosystem destruction, air pollution, water pollution and eutrophication of waterways (Matson, et al. 1997; Moss, 2008; Unsworth and Ormrod, 2013) may now be growing in recognition from a wider audience there are still many less recognized impacts throughout the food supply chain that industry specific education and awareness can positively influence (Deale and Barber., 2012).

2.5.2 Sustainability knowledge and awareness

Sustainability is an important factor in the ongoing operational performance of any business and as the previous chapter identifies the environmental impacts of the CFS are also influenced by many of the operational procedures of the RFSO sector.
Just as food safety knowledge and awareness is essential in RFSOs to prevent the transfer of bacteria or contamination of foods to the customer (FSANZ, 2002), the same argument may be had for the importance of knowledge and awareness in their sustainability performance.

History shows awareness campaigns have proven to be an effective tool in lessening environmental impact. The Clean-Up Sydney Harbour Day campaign was initiated in 1989 to collect rubbish and raise awareness on the effects of litter impacting the environment. The campaign was such a national success in 1993 it partnered with UNEP, and is now one of the most successful environmental campaigns in history, including participation from 39Million people in 132 countries (Cleanupday, 2017).

There are now numerous campaigns highlighting food waste including the more globally active partnership between UNEP, FAO and Messe Düsseldorf; Think.Eat.Save, and the United Kingdoms; Love Food Hate Waste campaign, which has since been adopted by the New South Wales and Victorian State governments (Lovefoodhatewaste, 2017, ThinkEatSave, 2014). Although these campaigns encourage awareness of the global food waste focussing primarily on domestic actions, there is still loss and waste in every stage of food processing (Gustavsson, et al. 2013) and no industry specific campaigns for one of the biggest consumers the RFSO sector.

Knowledge and awareness has long been accepted as an important influence on human behaviour, more specifically in an eco-awareness context, Young et al (2015) found that awareness and knowledge can improve employees' sustainable actions even if they don't appear to have pro-environmental attitudes. Research by Heeren et al (2016) suggest behavioural patterns and more specifically how participants engage in these behaviours are also important for success in sustainability education.

2.5.3 Sustainability behaviour

Although knowledge and awareness is important in promoting a subject's actions, research on sustainability education suggests engagement, attitude and perceived behavioural control are also important in achieving sustainability behavioural objectives (Swaim, et al. 2016).

A UK study on commercial kitchens by Mudie et al (2013) indicated staff behaviour is one of the greatest areas for improvement when it comes to resource consumption in the RFSO sector. As early stated the study showed electricity consumption of kitchen appliances could be reduced by up to 70% through greater behavioural habits. Also worth noting on the topic of sustainability behaviour in the RFSO is research suggesting environmental behaviours and attitudes are weakened when on vacation (Juvan and Dolnicar, 2017; Miller, et al. 2014). This research highlights the importance of selecting these key criteria in determining sustainability performance values due to the RFSO sector representing a major part of the tourism industry.

2.5.4 Sustainability management

It is widely accepted good management is essential for the success of any business, yet with a decrease in entry level requirements for trade cookery, minimal opportunities for skill development across the sector and the Australian Restaurant and Catering Association suggesting a shortfall of skilled workers to service the sector (RCA, 2014) the challenges for management in the industry are increasing. Adding to these challenges are the growing public awareness that the industry has aspects that are environmentally damaging (Christ and Burritt, 2017) and negative impacts of operations can have wider ramifications (dos Santos, et al. 2017) and the growing importance of greater sustainability management is an area requiring urgent attention.

Experts in the field of trend projections suggest sustainability, and a clear understanding of the environmental impacts of the business will be an essential tool in the success in the industry (Deale and Barber, 2012; Deloitte, 2014; Sloan, et al. 2013). Sustainability and the industry specific opportunities it is creating is growing in relevance, so too is recognition that a clear understanding of all it encompasses is essential for all future hospitality management (Sloan, et al. 2013). It therefore stands to

reason that sustainability management and indicators to measure sustainability performance should also be considered an important aspect of environmental mitigation specific to RFSOs.

In attempting to identify the best way forward in sustainability management the traditionally male dominant sector may now need revision after research by Fermani et al (2016) found women harbour higher environmental values than men in the hospitality industry. Furthermore, Park et al (2017) suggests success in environmental related activities in hotels are largely influenced by the environmental attitudes of the managers, and Jangs et al (2017) further confirms the importance of a managers' environmental values in promoting sustainability in the restaurant industry.
The implications of these studies in successful sustainability management could mean a changing of the guard, a dilution of the once male dominated profession to one more influenced by women and their environmental values best suited to the rising challenges in the sector. Research by Huang et al (2016) supports this theory, suggesting a servant style leadership is now required to positively influence the operational performance of outlets in the hospitality industry.

2.6 Literature review summary

The literature review identifies the CFS as a major contributor to environmental impacts across a range of natural environments and questions whether its current trajectory is sustainable. The review also identified a clear lack of academic literature on environmental sustainability awareness in the hospitality sector, even though the topic is recognised as a highly relevant issue (Fusi, et al. 2016; Jones, et al. 2016).
A study on environmental related research in the hospitality sector for the period 2000 - 2010 discovered merely six restaurants were represented from a total count of only 58 articles. Of these two focussed on water consumption and conservation and one was a study on environmental behaviour of management in the industry (Myung, et al. 2012).
The RFSO sector is reported to be one of the largest in Australia responsible for employing over 550,000 staff across almost 36,000 businesses (RCA, 2017). However, owing to a variety of factors including; long hours, stress, hot cramped kitchens and a culture of abuse and bullying (Bloisi and Hoel, 2008) the industry is often seen as place of high-staff turn-over, retention problems and labour shortages (Arnoldsson, 2015).

In 2010, Euromonitor International, a company specializing in global surveys, analytics and industry research placed the figure at US$1.85trillion (Murray, 2007) and in Australia, Restaurant and Catering Association suggest the sector contributes almost $16billion annually to the local economy (RCA, 2017) yet there is no recognised industry standard for sustainability certification or sustainability performance education.

Furthermore a recent Foodexecutive (2016) report suggest sustainability is one of the main future trends for the RFSO sector (yet compared to the business sector, the hospitality sector has been slow to react (Jones, et al. 2016). The RFSO sector, reliant on the CFS for survival, has not yet agreed to its definition of sustainability. Some research suggest its objectives may be focussed on business responsibilities rather than a genuine commitment to sustainability (Jones, et al. 2015) which may not gain credibility with consumers (Nilsson, et al. 2003).

From this literature review the case study to further identify resource consumption in the RFSO was reasoned substantial and relevant due to:

- the sustainability of the CFS trajectory and its reliance on finite resources,
- the RFSO influences the CFS through consumer and producer streams,
- the RFSO sector lacks comprehensive sustainability representation, and
- the sustainability performance of the RFSO sector requires further research.

What is also identified is although there are some industry relevant guidelines attempting to mitigate the environmental impacts of the RFSO, there is no set benchmark or common way to identify the sustainability performance of them, and as such, are difficult to measure success or failures.
Wasted resources is a growing concern in the industry not only due the unnecessary production of materials and produce, but also the increasing challenges in disposing or reutilizing of the material labelled as waste.
These issues are all factors in the sustainability performance of the RFSO sector and the following case study aims to identify if a sustainability performance program can influence this excess consumption of resources as well as identify opportunities for improvement and efficiency.

3. Research aims and objective

3.1 Hypothesis

Can a sustainability performance program influence the resource consumption of retail food service outlets?

Research indicated the RFSO industry is inefficient in its use of resources as well indicating a general lack of sustainability knowledge and awareness. Failure to offer industry specific sustainability training and sustainability performance tools may contribute to this. The research also indicated data on the volume of resource waste created per customer was often unmeasured and as such this case study aimed to capture this information.

Because of the lack of resource waste data and varying understanding of sustainability performance a waste data trial was planned as such:

- An RFSO specific sustainability performance program (SPP) was to be developed from information gathered during the literature review and exploratory research;
- Waste observations were to be recorded by participating RFSO for a defined period;
- Fifty percent of that group would undertake the SPP; and after a two-week period;
- All participants were to record the basic waste observations again, analysis of findings would identify any relationship between the SPP and waste streams.

4. Methodology

4.1 Researchers field experience

The researchers own experience consists of over two decades of experience in the food service sector, which prompted the initial research question.

4.2 Secondary research

The secondary data was accessed through various on-line searchable databases such as; Ebsco megafile, Science Direct, ABS, ebrary, ProQuest, Scopus & Emerald. The

researcher also used popular industry journals such as; Tourism and hospitality journal, Worldwide hospitality and tourism theme. These popular industry journals provided important information on what the industry considered were (or were not) important issues, and potential responses to those issues by industry respondents. Although it must be again noted recent and relevant studies on RFSO and hospitality waste streams and emissions is sparse.

This desk research was used to substantiate the focus of the key questions as well as strengthen the argument on the significance of the research.

4.3 Exploratory research

To validate the hypothesis an online survey was developed *(appendix 1)* aimed at identifying the sustainability awareness of RSO staff and was promoted using flyers *(appendix 2).* These flyers were designed, printed and delivered to 30 RFSOs across a 200km radius taking in areas of Brisbane and the Gold Coast appealing for participation from all staff in the RFSO and immediate supply chain. After a four-week period, and delivery of 120 flyers, the online survey was completed by only twelve participants.

Due to this slow uptake and further research suggesting one of the key methods of data collection for food systems is from interviews (SAFA, 2014) the researcher re-formulated the survey, and re-focussed attention to certain groups of relevance to the topic.

Between a 4-month period from September 2014 to January 2015 interviews were held with a variety of actors representative of the RFSO sector. The sample group of thirty-one participants included; local, state and federal government representatives, scientists, university professors, chefs (from executive to apprentice, café to stadium), culinary teachers, primary producers, waste managers, community group leaders, full-time researchers, consumers, hotel operators, business owners, food rescue organization managers and commercial waste managers.

The participants were contacted through email, phone calls and cold calling inviting them to be interviewed. All the interviews, apart from two who were interviewed over the phone, were done face-to-face.

The interview process was informal with the questioning guiding the theme, namely: Can a sustainability performance program influence resource management in the RFSO?

The interview results were then compiled to assist the structure of the case study.

4.4 Part 1

With feedback from the industry interviews and surveys the researchers' original points were confirmed; the RFSO industry is diverse in its comprehension of sustainability and the role it plays in the CFS, and, the importance of resource management may not be readily identified as a responsibility for all staff in the RFSO.
The SPP and waste data template was then developed with input from these interviews and the literature review. The SPP was developed as a terms of reference (TOR) pamphlet consisting of explanations and descriptions of industry specific terms for use by staff and PICs *(appendix 3)* as well as a resources "Think & Save" banner series *(appendix 7)*.

The "Think & Save" banner series was developed to encourage mindful behaviour in RFSO. Topics relating to resource waste and solutions were summarized and developed into bullet points, explaining current industry problems in various streams of RFSO along with solutions suggesting possible savings. Due to the researchers' experience in this field, specifically to the commercial kitchen environment where posters and banners need to stand out, it was reasoned bright animated characters would have maximum effect to represent each resource:

- Water,
- Gas,
- Electricity,
- Food waste, and
- Recycling.

These posters were first developed into a freehand sample for testing. The researcher invited feedback from four different PIC's and after some minor changes these were developed into sustainability awareness banner specific to the RFSO sector. The banners were printed in colour, laminated and prepared with double sided adhesive tape for mounting on the wall.

Informal meetings were then held which included representation from the state culinary federation, TAFE teachers, business owners and hotel executive chefs to

discuss the waste trial, SPP and support in recruiting industry members for the waste trial. Feedback from these face-to-face meetings was positive and commitment to the trial were tentatively confirmed. The waste trial was then tested by an individual RFSO over a period of ten days to gain feedback on ease of use, comprehension of the SPP as well as any challenges regarding recording of observational waste measurements. After minor editing to the approach documentation the recruitment process was undertaken.

4.4.1 Design

Part 1 (P1) of the case study aimed to recruit a minimum 20 RFSO's across a similar style; all café style, serving at least 2 meals per day for minimum five days with capacity for 20-80 seats. This style of RFSO was chosen as research indicated was the most common RFSO in the study area, namely the 200km radius. The study then aimed to measure the waste generated through five different streams as well as the amount of customers served during a two-week period

The outputs of the RFSO was to be measured daily, consisting of observational measurements of recyclable packaging waste (cardboard/paper/glass/plastic) and general waste discarded.

The RFSO's were to be given a number from 1 – 20 identifying them as a number in the trial (no business names would be used and only the postcode to establish the area be invited).

In some commercial operations cardboard is recycled and collected in a wire cage from the rubbish company, therefore an estimation would apply whereby the cardboard were to be measured against the capacity of a 240liter 'wheelie' bin, with the amount from each day being recorded in the printed sheet provided. The other plastic/glass/tin/paper materials were to be measured using the same wheelie bin measurement and recorded in the same book.

Waste normally discarded as general waste for landfill was to be measured using an 80 litre bin estimation measurement. The RFSO's in this study were all under the 80 seat limit the 80-litre bin is the most common method of waste collection in these venue types. Cooking oil and other fats are normally discarded in a grease trap or more commonly collected for recycling in a drum. Collection of oil is dependent on how busy the establishment is however oil is typically measured in a 20-litre drum/tub. Twenty

litres are the size of a standard drum for cooking oil and is also the size of the tub commonly used for liquid transport and storage in a kitchen. With this reasoning the oils were to be measured against the size of a 20-litre volume.
As per job description the kitchenhand, on average the position filled by persons with the least amount of educational achievements, would normally collect all waste from the RFSO, therefore the training for the correct method of measurement and documentation of wastage will need to be specific and easy to understand.

The bins would be divided into two separate parts and will be allocated a letter valuing the bin volume. In this study letters are given instead of numbers to keep the accuracy of the recordings. The letter (E) will represent the bins volume up-to 50% of capacity (half full), and the letter (F) will represent the volume of the bin over 50% of capacity (half full – full). When recorded on the table the type of waste disposal will be represented by a letter: garbage (G) wheelie (W) cardboard (C) and oil (O).
Therefore, an example of a day's recordings may look like this: G = F+F / W = F+F+E / C = F / O = E. This will identify the recording of; two full bins (G), two and a half (W), one full (C) and under ten litres (O) *(appendix 4).*

4.4.2 Data collection

At the end of the one-week period the recorded data would be collected with a brief interview consisting of the RFSO representative to discuss any questions or problems that the data collecting may have identified.
The collected data would then be totalled per outlet and divided against the total customers served in the same period to give an indication of resources consumed and waste created per customer for the week period. Waste (G+W+C+O)/ Customers served (P) = X

4.4.3 Program exercise

SPP - The next stage required half of the participating RFSO's to undertake the SPP for the period of two-weeks. This process required full involvement from all staff initially consisting of interactive workshops. These workshops were planned to discuss sustainability performance indicators in the RFSO, the environmental impact of the food

system, the banner series and the SP induction printout of the TOR guide. Staff collaboration was also required in the development of a sustainability management plan including waste management and water management, and innovative solutions combat the issue of materials previously considered waste.

4.4.4 Stage 2 Data recording

Re-trial - After the group were to participate in the two-week SPP, the program would require the total of the original participants to undertake the waste data recording again in the same manner as before for a period of one-week.

4.4.5 Results analysis

Analysis – This stage was to involve analysis of the data in an attempt to identify whether any correlation exists between the RFSO that participated in the SPP. The original answers from the initial survey would also be discussed to ascertain whether a retail food service outlet (RFSO) sustainability program may have an influence on RFSO staff and a measured impact on resource consumption.

4.4.6 Part 1 Conclusion

Although when originally approached to participate in the waste recording study the twenty PICs were enthusiastic and agreeable to the terms of the case study, after several unsuccessful attempts over a period of two months to confirm recruitment only two (2) PICs were happy to confirm participation. Due to these unsuitable sampling conditions the waste trial and SPP was cancelled by the researcher.

In gathering feedback and reasons why participants could not commit to the study it became apparent time management issues were one of the main reasons for non-compliance, as well as the de-valuing of the SPP itself. Time management feedback suggested staff difficulty in committing to any extra work on-top of set work schedule. In reference to environmental impacts from the food system and in particular the RFSO, the general consensus was that sustainability and environmental issues were not priority as they are perceived to cost money rather than make money. The feedback

suggested any sustainability programs had to show economic benefit as the environmental impacts were not of major concern unless there was a recognised economic advantage in addressing them. The initial recruitment attempt was summed up best by the head chef from an award winning restaurant: *we don't have time to learn about that stuff, we're too busy with real work.*

Summarizing P1 the two major factors for non-participation were;

- lack of time availability to commit to the trial, and
- could not see any financial benefit in participating.

The responders were also collectively adamant their venues were operating efficiently and sustainably and resource waste not an issue.

Yet P1 also provided important learnings that could be adopted in a follow up case study, Part 2 (P2) which sought to address the sustainability performance of these RFSOs. This included the need to ensure that data collection approaches did not require substantial time commitment, were easy to understand (writing style and simple and meaningful messages), and had to offer financial incentive (or some other alternative for the owner/operator to justify interrupting staff and service).

4.5 Part 2

4.5.1 Survey design

In an attempt to discover the sustainability performance of the RFSOs key criteria were identified from the literature review and recognised industry guidelines to form the basis of the survey *(appendix 5).*

The key criteria used to identify the sustainability performance of RFSO were:

- Sustainability management,
- Staff education & training,
- Sustainability knowledge & awareness, and
- Sustainability behavior.

The researcher also included a variety of demographic categories to identify any relationships which may exist between these indicators.

The questions were rated true = 1, false = 4, and unsure = 3 which was then used to categories responses in relation to the questions *(appendix 6).*

4.5.1.1 Sample categorization/ demographic indicators: 1-5

This initial information was to be used to batch the respondents into specific categories including;

- age,
- education level,
- period of employment,
- time in industry,

and the sustainability performance indicators.

Demographics are frequently an important factor in understanding work and behaviour responses to individuals or groups (Tsui & O'reilly, 1989). It can aid understanding impediments to change and facilitate solutions that are potentially practical to implement effectively. The initial personal questions were developed as general categories instead of specifics requiring minimum effort and time on behalf of the respondents.

The questions from one (1) to five (5) comprised general age/sex/education/outlet questions to develop a greater understanding of the sampling type as well as enabling the participant to feel comfortable with the survey and not feel overwhelmed. Evidence suggests response styles will be affected when cognitive load increases, therefore by making initial question easy to answer it is viewed that respondents may have a greater chance of reflecting their true opinions when they are relaxed and questions require less thought (Van Vaerenbergh and Thomas, 2013).

It is widely accepted the industry norm in traditional kitchens are male dominant, often due to the hard physical work, aggression, and at times high stress conditions (Arnoldson, 2015, Pratten, 2003). In a 2017 newspaper article on women in kitchens, it points out of the 172 Michelin starred chefs in the UK only ten have female head chefs (Alexander, 2017). This is further supported by Pratten (2003) who in researching training and retention of chefs noted a common occurrence at one catering college where only four females were represented in an enrolment of 22 recruits. Identifying the gender of participants for this survey is important as it can impact on their attitude and behaviour. A study by Laroche et al (2001) found a larger section of females are

willing to pay more for environmental products in comparison to males, highlighting the relevance of demographics in RFSOs.

4.5.1.2 Staff education and training indicators: 6 – 9

As the literature states education and training can be important factors in achieving efficient sustainability performance. These questions were included in the survey to identify if any links were apparent.

Questions six (6) to nine (9) attempt to discover education and any recent training the respondents have undertaken in an effort to establish a base average education level for the various positions held in the RFSO. As this paper has shown previously there is limited opportunity for staff in this sector to upskill yet some of the industry trends require consistent and specific knowledge and training. These sets of questions aim to identify gaps in the area of training and education as well as be used to identify relationships or correlations exists between education/ training and resource consumption, environmental awareness and other sustainability factors.

4.5.1.3 Sustainability knowledge and awareness: 10 – 14

Questions ten (10) to fourteen (14) attempts to understand the sustainability knowledge of the participants. These questions are a fair representation of general sustainability knowledge that were uncovered during the initial interviews.

Specifically question twelve (12) is a trick question that, if correctly answered would show the participants knowledge; that 'trade waste' is in fact not something that can be disposed of in a bin, rather it is the waterborne waste from a business which is discharged of into the sewer (Water supply act, 2008).

This questions importance was highlighted by Prassad et al (2004) who identified not only inefficiencies in the businesses, but more notably the fact the majority of the respondents interviewed did not understand the term trade waste. As a specialized businesses recognised by government in the disposing of oils, grease, cleaning products and chemicals, trade waste can be a major factor in the environmental impact of a RFSO, and therefore must be managed accordingly to achieve sustainability performance.

4.5.1.4 Sustainability behaviour: 15 – 20

Questions fifteen (15) to twenty (20) are focussed on resource management in the RFSO sector and aimed to identify resource management patterns of the RFSO. Enabling the participants to identify potential wastage of resources; food, gas, water and electricity, the survey attempts to establish an understanding of the waste witnessed. These questions were also designed with a large response type so that participants have the option to answer more specifically between the responses; all the time, occasionally, sometimes and never.

By placing this set of question directly after the simpler true and false answers, where responding requires less cognitive load the respondents would be expected to answer these style of question with greater reliability (Van Vaerenbergh and Thomas, 2013). This questions hold particular relevance in understanding what streams are being perceived as waste and to strengthen the validity of results of the observation of the outlet.

4.5.1.5 Sustainability management: 21 – 25

Sustainability management is a key indicator of sustainability performance in the RFSO sector. Although resources such as gas, electricity, water and food are essential in the operation of many RFSOs it is through effective management of these resources that positive sustainability performance may be achieved. Exploratory research identified although it was common to restrict resource inputs to reduce economic cost the value of the outputs was often neglected. Due to output costs involved with waste disposal, nutrient value of the organic waste, and potential social benefits in allowing staff to take home food past its best date, a question was developed to identify this sustainability performance indicator.

Questions twenty-one (21) to twenty-five (25) identify sustainability management through waste stream management which includes bin numbers, composting, and resource usage incentive program.

Exploratory research indicated that lack of bin area and infrequent rubbish removal services was a factor in waste stream management. Research also indicates due to the minimal waste levy in Queensland in compared to the rest of the country, waste separation and recycling is a challenge (Ritchie, 2016).

Due to reasons already mentioned in the literature review, namely the difficulties in getting accurate waste data from RFSOs, bin numbers and waste stream information can also contribute to a greater understanding of the waste stream flow be useful in identifying sustainability performance.

Question twenty-three (23) is used to assess any RFSO that has some form of edible garden to encourage either plant carting/maintenance and composting. There is general consensus that some staff in RFSO may be becoming detached from the natural processes of the food system and herb or vegetable garden program may add arrange of benefits including positive food choices, increased nutrition knowledge and may offer greater valuation of fresh produce (Bellows, et al. 2003; Lautenschlager and Smith, 2007; Ober, et al. 2008).

Question twenty-four (24) is aimed at identifying whether there is left-over food, whether there is a culture of taking home left-over food, and was also be used to identify whether some staff are allowed to take home food more than others.

The final question in the survey, twenty-five (25) aims to identify whether any RFSO undertakes a form of incentive to encourage resource reduction. Exploratory research indicated a lack of programs or incentives available, which may be an area that can be immediately improved upon.

4.5.2 Implementation

In the attempt to score each RFSO with a sustainability performance score (SPS) all staff members were requested to participate in the survey; to represent the RFSO, and also the RFSO sector as a combined response. In all instances the researcher managed to get full participation from all the staff working that particular shift, including front of house, all management and all back of house staff.

To guarantee ethics protocol and privacy of the collected data the researcher would remain present in each establishment until all surveys were filled out and collected from each participant. This system assisted in the secure collection and storage of personal data from participants, and because the surveys were not being collected by work colleagues or management staff, it was reasoned this encouraged a greater honesty in the responses.

4.5.3 Incentive - RFSO Banner series

As discovered earlier in the study the PIC of the RFSO would not voluntarily donate time to the researcher. The reasoning from RFSO operators was in part due to the lost time of staff equated to money, and therefore unless the researcher could equal that benefit, invitation to participate in the study was met with a negative response.
To combat this the PICs of each outlet was offered a laminated set of the resource "Think Save" banner series (developed for P1) as well as access to the downloadable PDF online *(appendix 7).*

4.5.4 Sustainability Performance Score Audit

To further validate and substantiate the sustainability performance scores awarded to each RFSO from the respondent's answers an audit was developed to score the RFSO premises on sustainability performance using a set of sustainability indicators. The audit was designed as an observational style process of the RFSO with a major focus on the kitchen, due to it typically being the area for the main inputs and outputs of this type of business.

The development of the audits key criteria and performance indicators were guided by research from the literature review, adhering to certain parameters essential for developing sustainability indicators. The researcher also used their extensive experience in the operational performance of the sector as well as choosing relevant sustainability criteria from recognised industry bodies including; Sustainable Restaurant Association (SRA) Green Restaurant Association and FAO's Sustainability Assessment of Food and Agricultural Systems (SAFA).

Three new key criteria of sustainability performance specific to RFSO physical venue were identified:

1. Resource streams (1-4);
2. Sustainability management (5-9); and,
3. RFSO and equipment (10-11),

and then eleven elements representing the major indicators of sustainability performance for the RFSO audit from these which are as follows:

1. Energy

2. Water
3. Chemical usage
4. Waste
5. Eco – awareness
6. Food sustainability (Menu)
7. Sustainability management (Back-of-house)
8. Sustainability management (Front-of-house)
9. Equipment
10. Food safety rating/score
11. Design

These indicators were then further developed to create a system of 81 observable points specific to the RFSO sector with a score appropriate from one to four (1-4) enabling a better representation of the sustainability performance of the venue. *(appendix 8)*

The audit sheet was designed with the numbers representing sustainability performance:

- one (1) = good (best case scenario)
- two (2) = satisfactory
- three (3) = unsatisfactory
- four (4) = poor (worst case scenario).

To minimize interference, the walk-around audit was designed to assess kitchens in-between food service, and if this time was not available, auditing during food preparation time was required.

The audit was designed for the auditor to start at the front of the RFSO to observe window shade, air conditioner and air-curtain (if applicable), and then proceed to the kitchen (largest consumer of energy/ generator of waste) and accesses the kitchen including: sink/ wash-up area, coolroom/refrigerated storage, hot section, dry-store and main bin area as well as assess the businesses environmental surrounds.

To assist substantiate quantitative data it was requested for the RFSO owner/ manager to make available any electronic or paper proof of: self-metered energy, equipment servicing chart, sustainability management plan, cleaning schedule and waste management plan.

The executive/ head chef was also requested to make available proof regarding: Cleaning roster, charts and notes of chemical dilution amounts, produce suppliers, food re-use plan and temperature charts to assist in the SP score *(appendix 9).*

5. Results (P2)

The survey representing a sample of RFSO actors encountered challenges when attempting recruitment. Of the 30 RFSOs approached for recruitment for this survey a total of nine (9) agreed to participate. Out of these RFSOs, where literacy and time was not an issue, a total of sixty-eight (68) of the available staff completed the survey. On some occasions not all present staff were able to complete survey. The main reason was English literacy skills for a number of potential respondents who did not have English as their first language. On two separate occasions this figure represented almost half the kitchen staff and half the floor/bar staff. In many circumstances the PIC did not welcome the idea of their staff taking part in a survey questioning the performance of the business even though confidentiality and ethics protocol was assured. Although less than 30% recruitment by face-to-face introduction and invitation this number is more successful than the original uptake of 10% for the online survey request (ch4.3), which may partially be attributed to the banner series "Think Save" and their perceived value by the RFSOs PIC.

5.1 Demographics

To aid in the critical discussion of the SP the demographic details were broken down into categories to assist in identifying the representation of participants. As discussed in the literature review these categories such as; age group, time in industry, gender distribution in FOH & BOH, as well as education currently achieved were deemed relevant for this analysis.

Analysis of the participant's surveys showed 43% of RFSO workers were from the 24-31 age group category, with the age groups of 16-23 and 32-39 being equally represented at 20.5%, the 40-47 represented with 13% and a 3% representation for the age group over 48 years as shown in the chart (figure 12).

Overall, the majority of the participants were male 62%. Females made up the majority of the FOH at 65%, however in the BOH females were represented by only 8% of staff compared to the males accounting for 92%. Further analysis of the RFSOs results suggested males made up 50% of BOH and 19% FOH with females representing 28% FOH and only 3% BOH of the café/ eatery. Figures from the restaurants/ event venues suggested males were represented by 37% BOH and 16% FOH and females were represented at 41% FOH and 6% BOH.

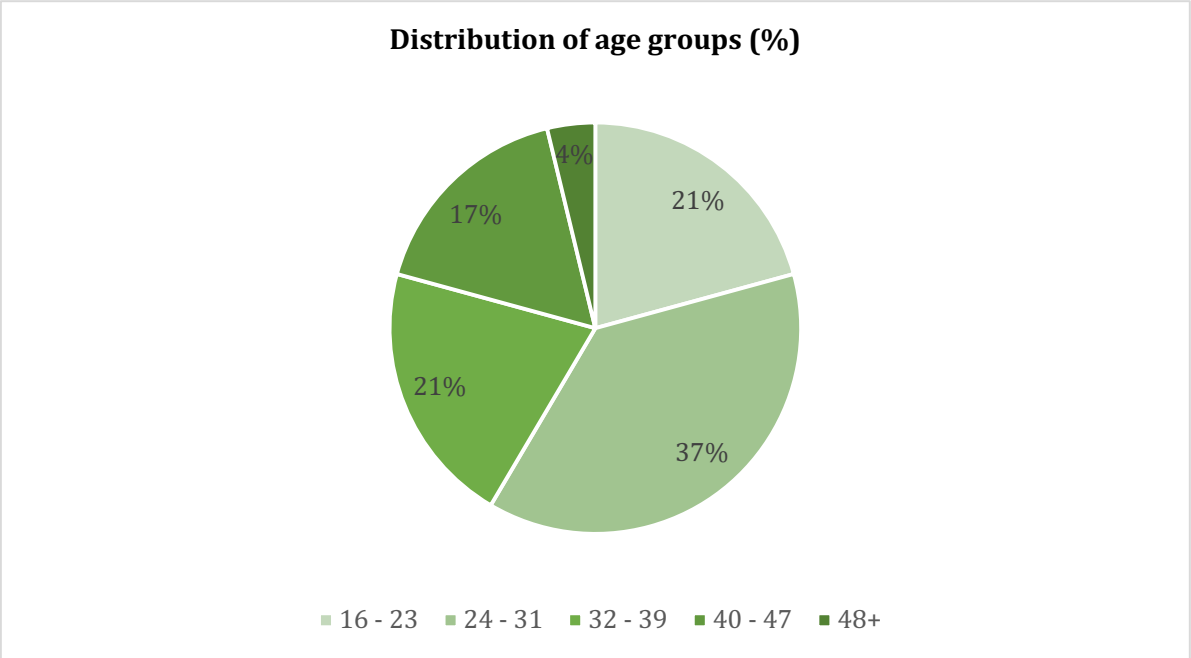


Figure 12. RFSO participants - Age group distribution.

These results also indicated the heavily male dominated BOH with 44% of all staff male and only 4% representation by females (Figure13). Although the FOH showed bias in gender distribution with females' dominant at 34% the males also represented 18% FOH. This confirms the traditional belief that the RFSO sector is male dominant with the participants of this survey showing 62% male representation in relation to females at 38%.

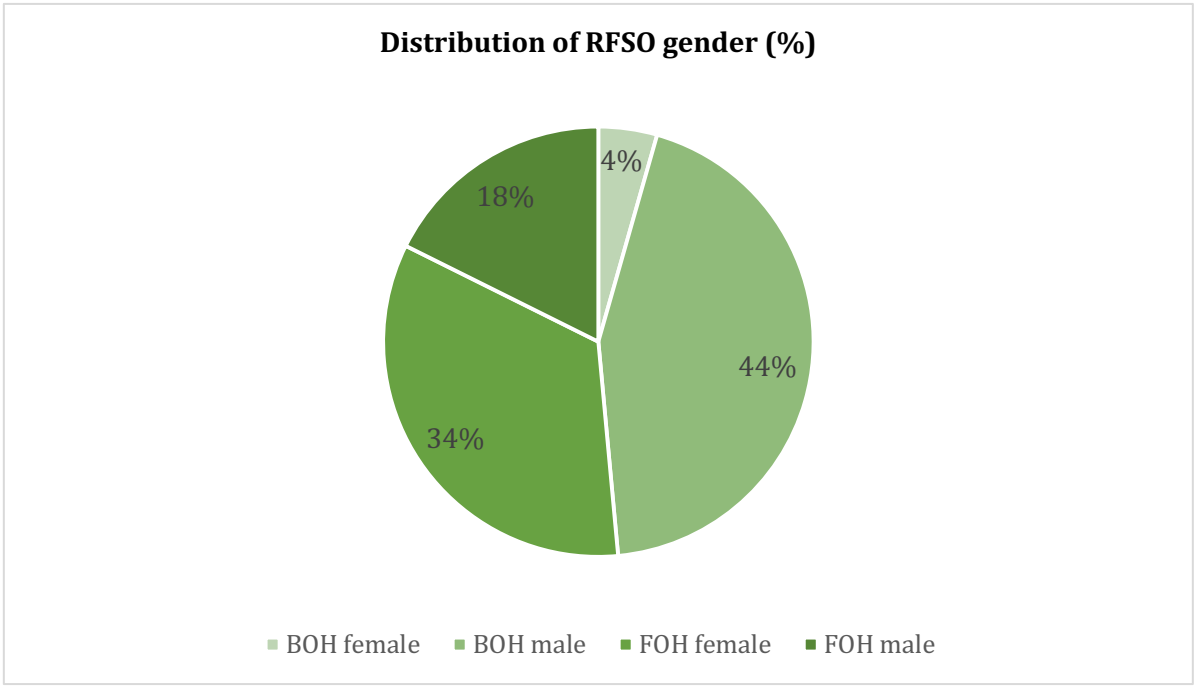


Figure 13. Distribution of RFSO gender of participants.

The survey results also indicated the majority of the staff had been working in the RFSO industry from the 1-5 year category at 40%, the second largest group was from the 6 - 10 years at 23%, followed by the 16 year and over group at 15%, 11-15 year group at 12%, and the under 1 year group at 10% as seen in figure 14.

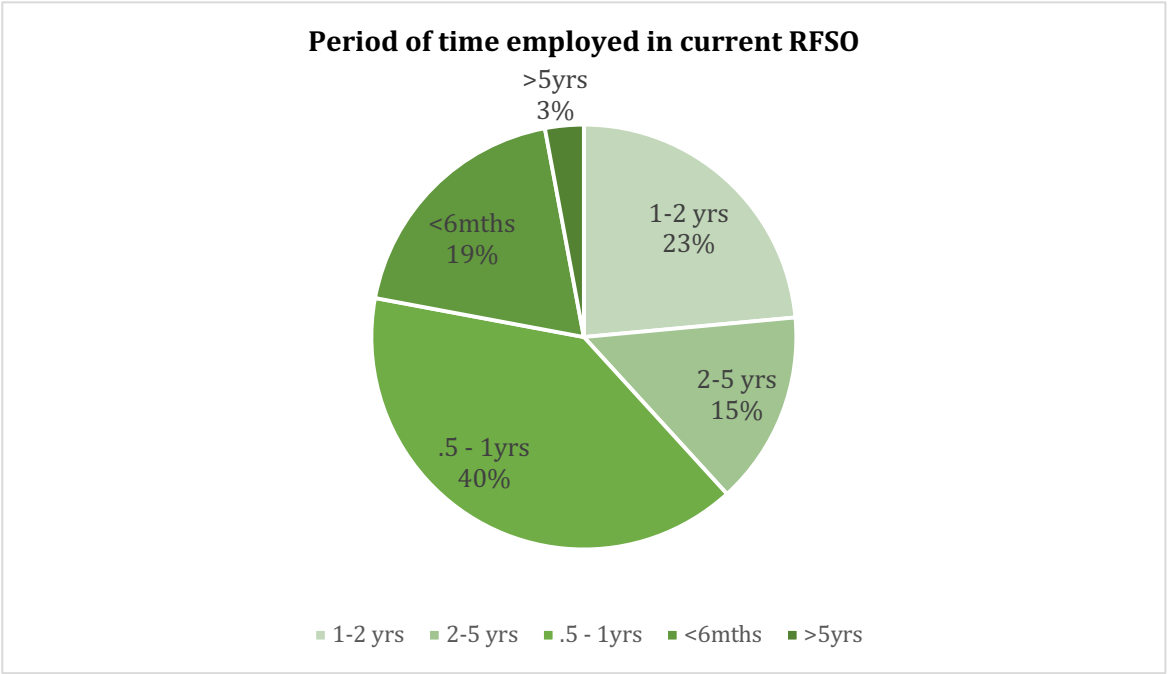


Figure 14. Period of employment in current RFSO.

5.2 Staff education and training

In terms of education level currently achieved among RFSP participants the results suggest participants in the extreme fields of the categories were represented by the smallest group, postgraduate (PG) at 6% and up-to- year 10 (>10) at 7%. The undergraduate category was represented by 9%, the year 10 plus formal tertiary training and year 12 plus formal tertiary training equally represented at 23.5%. At 31% the year 12 level accounted for the greatest percentage of this category (figure15).

Separating the back of house (BOH) from front of house (FOS) staff, the BOH accounted for the greater representation of the up-to year 10, year 10+, whereas the year 12 category was tripled by FOH at 24% compared to the BOH at 7.2%.
Although the year 12+ diploma/certificate figures suggested a common trend at 10% (BOH) and 13% (FOH) the university recognised achievements dropped significantly with the BOH represented by 3% and FOH tripled this with 11.7% (figure16).

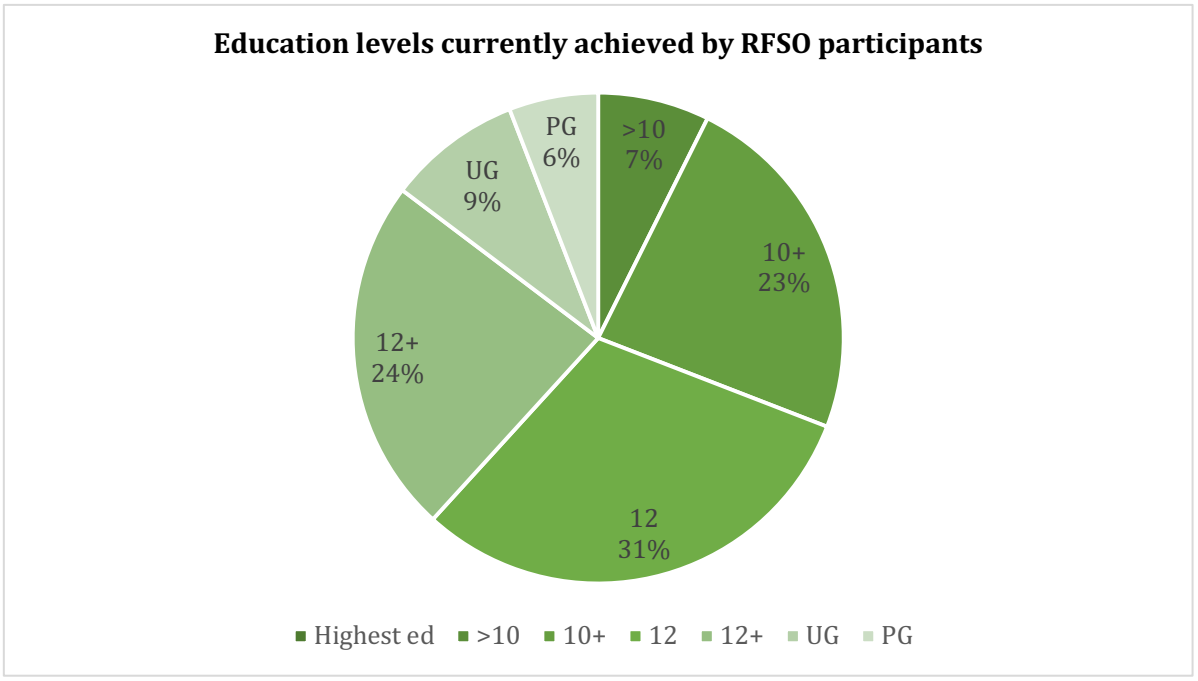


Figure 15. Highest to lowest levels of education achieved by RFSO actors.

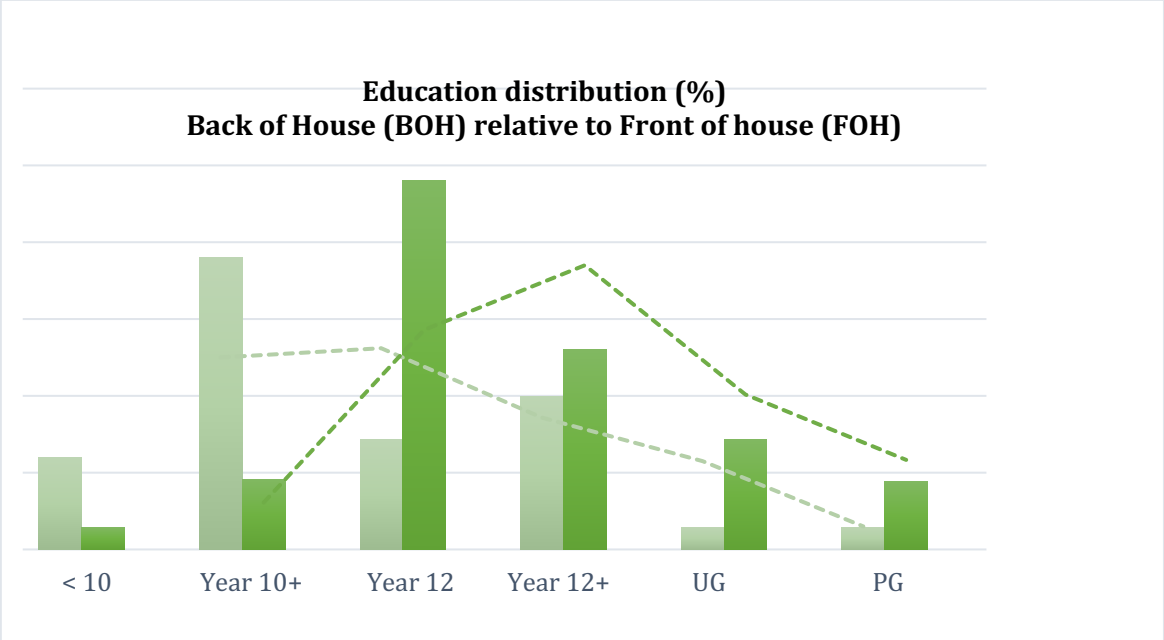


Figure 16. Education levels of RFSO participants separated between back-of-house and front-of-house.

5.3 Sustainability knowledge and awareness

The sustainability knowledge and awareness from participants was only 50% which equated to a sustainability score of 2.3 (Figure 17).

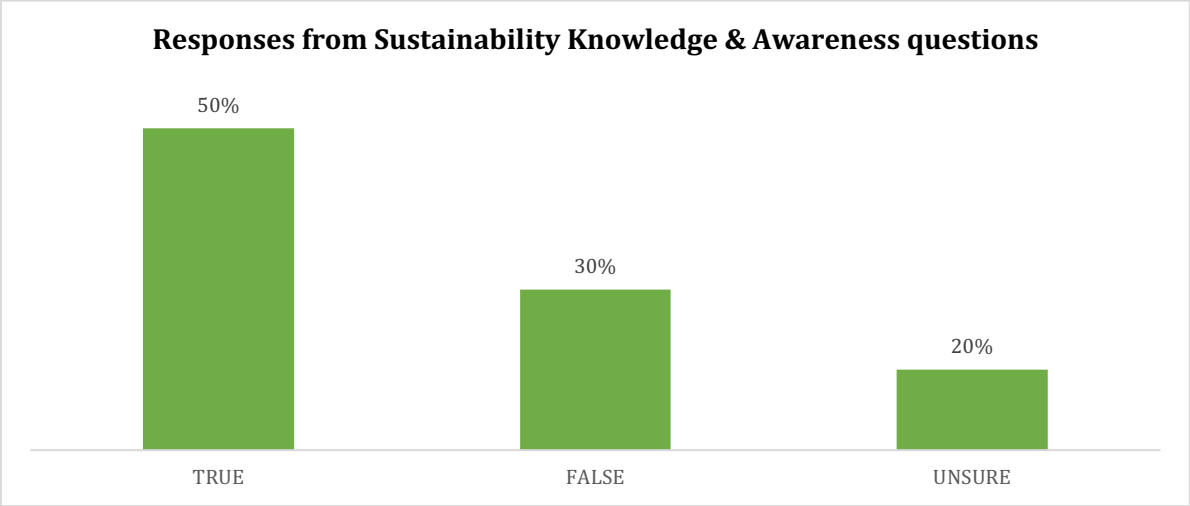


Figure 17. Percentage of True/ False/ Unsure responses from participants - Knowledge & awareness questions.

5.4 Sustainability behaviour

In response to staff witnessing resource waste, at least 91% had witnessed some form of resource waste and only 4-9% had never witnessed any form, as depicted in figure 18.

Figure 18. Witnessing wastage of resource streams in participating RFSOs.

Energy

Survey respondents reported witnessing gas wasted in the outlets:

- 6% consistently
- 47% occasionally
- 35% sometimes
- 12% never.

These responses suggest that only 12% of participants have ever not witnessed gas being used for no apparent purpose.

In relation to the electricity wastage witnessed the responses were:

- 9% consistently
- 21% occasionally
- 44% sometimes
- 26% never.

Although these outlets all had a variety of different gas and electrical appliances it may be noted that the larger portion of equipment in RFSO, both FOH and FOH may operate using electricity. Examples of this include: ceiling lights, air-conditioning/ heating, coffee machine, exhaust hood, dishwasher, fridges, freezers, combi-ovens, grills, deep fryers, and a large range of bench-top appliances. Comparatively, the appliances representing

gas usage are now fairly minimal in comparison, however they can still include: Grills, deep fryers, out-door heaters, stove tops, ovens and hot water systems.

5.5 Sustainability management

Only 27% of sustainability management (SM) was represented as *Satisfactory or Good (23% & 4%)* with *Poor* and *Very Poor* accounting for 73% of responses (32% and 41% accordingly). Even though the highest sustainability performance (SP) rating of *Good* from all categories were from sustainability knowledge and awareness (SK&A) at 50% this has not translated across to sustainability behaviour (SB) as can be seen by the chart representing responses (figure 19).

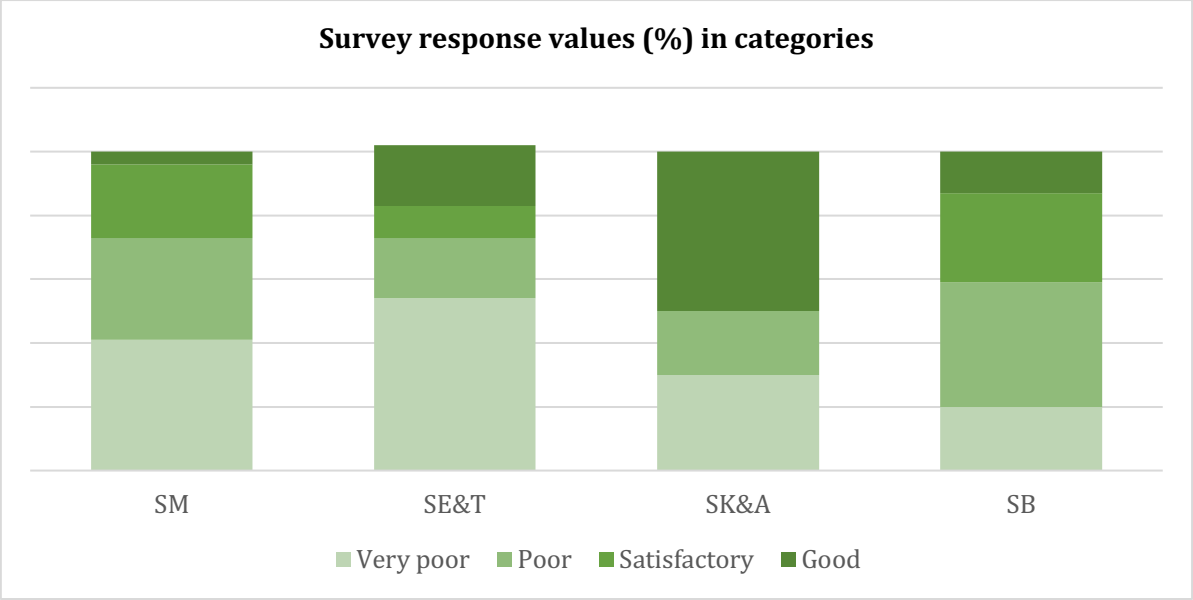


Figure 19. Sustainability management rating of outlet from survey responses.

5.6 Sustainability Performance Score

In reference to the collective sustainability scores from the walk-around audit, a radar graph was used, as shown in figure 17. The results identified the SM – FOH to be the worst performer at 3.65 (out of 4), while the eco-awareness rating, which was generated from observing physical indicators in the outlets, was the second worst performer at 3.44. Interestingly the best performing category with a score of 2.02 is the food safety score, adapted from the Councils own health and safety score[6], reasoning this score is

[6] This score is allocated by environmental health and safety officers from food safety audits.

collectively low as it is the only SP indicator in the RFSO with any compulsory regulatory framework that includes third party audits and demerits.

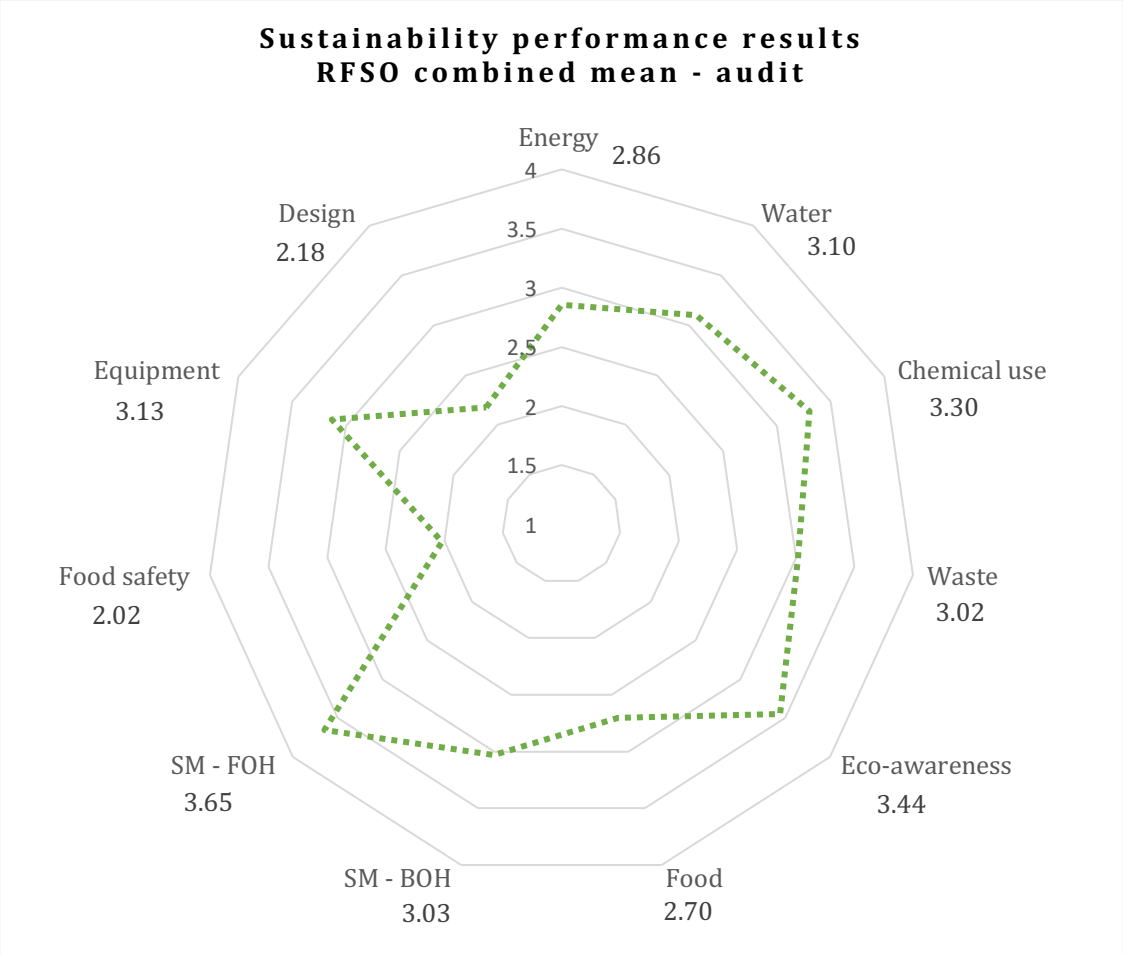
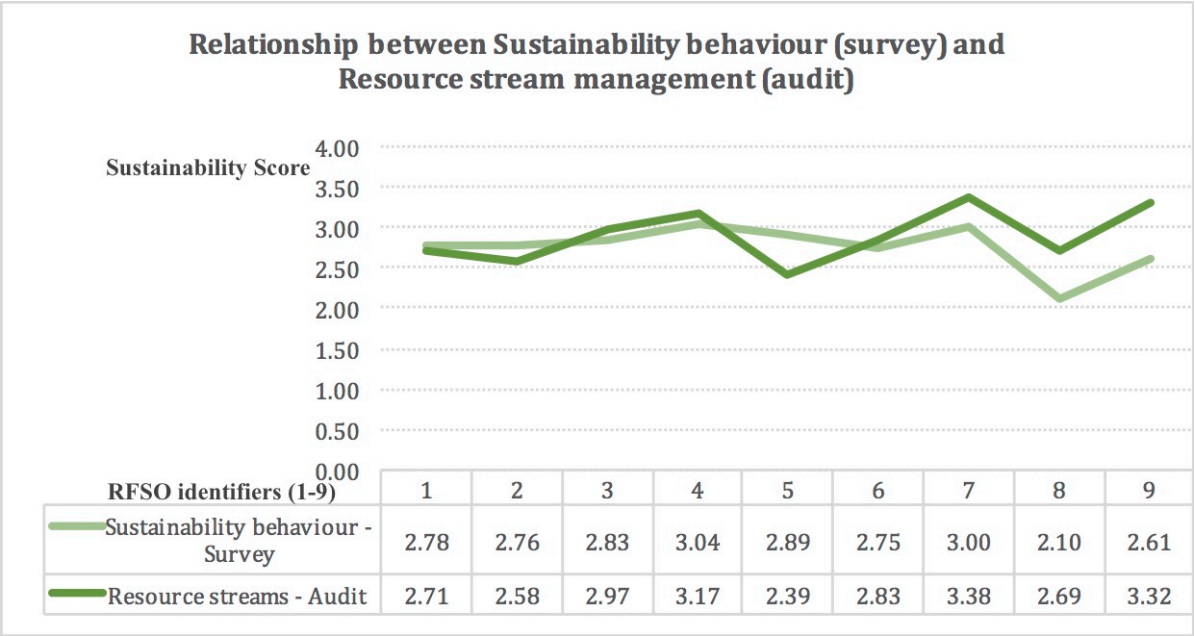


Figure 20. Sustainability performance score of collective RFSOs shown as radar graph.

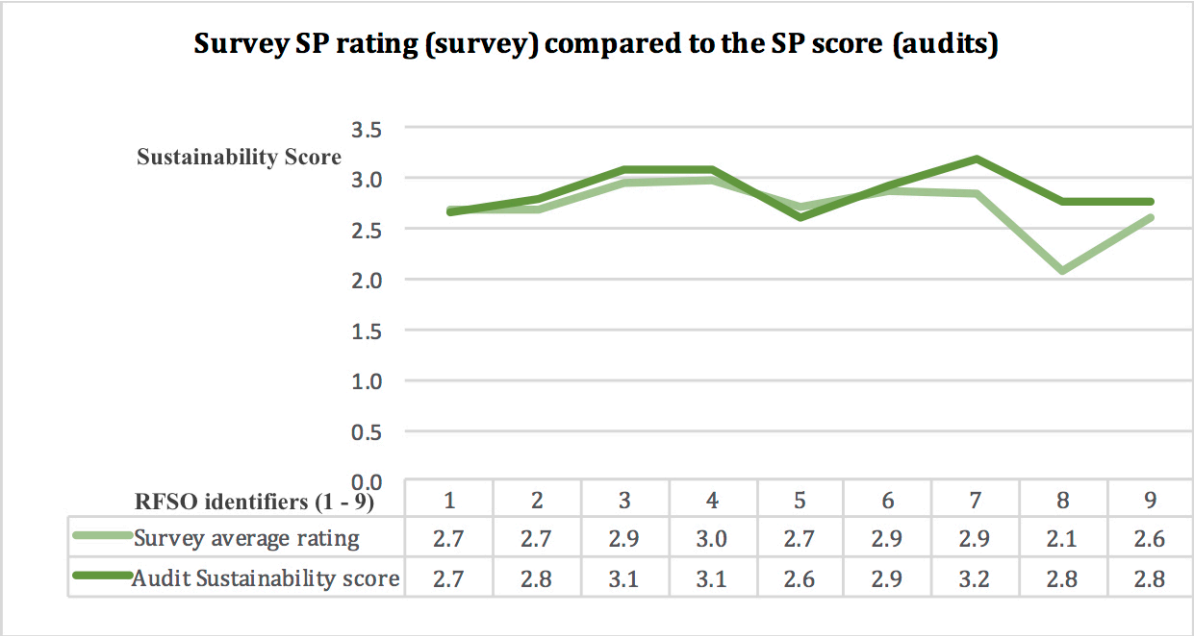
The SPI representing waste stream management were represented in both the survey and the audit. The responses identified a relationship (r:0.27) to exist between the responses from the survey and the audit, as shown in figure 21.



RFSO identifiers (1-9)	1	2	3	4	5	6	7	8	9
Sustainability behaviour - Survey	2.78	2.76	2.83	3.04	2.89	2.75	3.00	2.10	2.61
Resource streams - Audit	2.71	2.58	2.97	3.17	2.39	2.83	3.38	2.69	3.32

Figure 21. Comparisons between survey and audit responses to resource management & sustainability behaviour.

All survey responses were totalled with a mean value representing each RFSO. This same process was also applied to the SP scores from the audit. These RFSO survey values and audit scores were then compared to identify if relationship existed between these two sets (figure 22).



RFSO identifiers (1 - 9)	1	2	3	4	5	6	7	8	9
Survey average rating	2.7	2.7	2.9	3.0	2.7	2.9	2.9	2.1	2.6
Audit Sustainability score	2.7	2.8	3.1	3.1	2.6	2.9	3.2	2.8	2.8

Figure 22. SP - Survey rating and Audit score.

Overall the initial findings demonstrated both a lack of awareness of some sustainability issues and/or the practical challenge of acting on them in the business environment of the RFSO.

6. Discussion

In many circumstances the PIC did not welcome the idea of their staff taking part in a survey questioning the performance of the business even though confidentiality and ethics protocol was assured. Although less than 30% recruitment by face-to-face introduction and invitation this number is more successful than the original uptake of 10% for the online survey request (ch4.3).

Staff members of RFSO in general had limited time or willingness for completing surveys and being involved in this project in general, and indeed doing anything to think about and change operational practices was significant. This was despite the author using his extensive practical knowledge of the RFSO sector to tailor survey instruments and approaches as well as possible. The limitation that emerged substantially reduced the sample sizes of the surveys, but nonetheless relevant information was collected. The lack of time by participants is also a potential concern for the sector as a whole. The lack of time reflects specifically and substantial challenges faced by the RFSO sector were profit margins are narrow and work hours and effort to generate income are high. The short term focus on achieving profitability means that medium and longer term goals such as waste management strategies and other sustainability performance objectives are not a recognised priority.

An important note to add is the fact most if not all of the kitchens observed had only one stream of bin operational, general waste. Although many surveys responded to a variety of different streams on inspection of the waste recovery area no recycle bins or separate cardboard bins were found.

6.1 Demographics of sample

Although the researchers primary focus was on the sustainability performance of the RFSO sector, each outlet was represented by staff (referred to as actors) which make up the service team. In attempting to identify sustainability performance of the RFSO individual demographics are required to see if any relationships exist between demographic and sustainability performance identifiers.

RFSO staff represented by young staff with high turn-over

As shown in the analysis the survey indicated 79% of the respondents were between the 16-39-year category and also indicated the age groups of 40 - 47 and over 48 were minimally represented at 21%. This younger age dominance may partly be due to the hospitality industry's image of a "cool" party atmosphere (Choi, et al. 2013) and being a *seemingly easy profession to get into* (Blake, et al. 2006; Pratten, 2003), however decline in age throughout the industry may cause other concerns as highlighted by Martin and Gardiner (2007) investigating ageism in the hospitality sector. This study on ageism in hospitality highlighted earlier reports by Lucas (1993) and Meyer and Meyer (1998) indicating there was a negative perception of older hospitality staff in employment and they also presented "a negative link" to the target market. Some specific points suggested older staff were; harder to train, physically weaker, showed decline in drive, and did not fit the fast paced youthful image (Martin and Gardiner, 2007).

According to the result in this recent survey responses identified a huge 82% of all participants had worked in their current business less than 2 years, suggesting a relatively high staff-turnover, once again corresponding to industry norm (Kim, et al. 2015; Pratten, 2003; Vasque, 2014). Further analysis identified only three percent (3%) of respondents had worked for greater than five (5) years in the same RFSO. This supports the widely accepted perception that the RFSO experiences higher than normal staff turnover and highlights future challenges in developing programs specific to this sector.

High male representation BOH

Overall, there was a disparity in the gender make-up of the respondents within RFSOs. Although an obvious difference in the FOH (male 35% and female 65%) BOH was significant with 92% male and only 8% representing female. In terms of sustainability management and practices these finding are important in developing appropriate training as outlined in the literature review as females more inclined to pay more for product they feel are eco-friendly.

Although females represented the FOH their representation in management and owner/ investor position was poorly represented.

6.2 Education & training

The RFSO sector is unique in that it not only provides goods in the form of food and drink, it also provides a service, and because of this is reliant on a variety of educated and skilled staff to provide these goods and services, otherwise known as human capital (HC). Staff training, education and skill development are all important measures of human capital, which have been proven to improve competitiveness, enhance service quality, commitment, retention and is fundamental in delivering managerial objectives in the tourism industry (Blake, et al. 2006; Eaglen, et al. 2000; Thomas and Long, 2001).

The issue of not training staff due to the expected short term of employment has created a vicious cycle common to the industry. Retention of skilled labour is an increasing concern in and affected by many influences including lack of suitable training (Pratten, 2003) and wages not high enough to prevent employees leaving to other industries (Blake, et al. 2006). Due to a common business model of requiring return on investment (ROI) the implications of high staff turn-over, common in the industry, may then make it difficult for owners to justify spending time and resources on training. A business is unlikely to invest significant time and resources in training beyond ensuring that day to day work is carried out efficiently (Arnoldsson, 2015; Pratten, 2015) if the expectation is that staff will only be employed for a relatively short period of time. Furthermore, due to the hospitality's relationship with tourism, often reliant on seasonal trade, the longevity of an RFSO business may often be relatively short, and in some respects they can be considered ephemeral.

In regards to education and training and recognising that some of the staff were unable to participate due to literacy challenges, it is important to identify these challenges when catering for overseas and migrant workers in the RFSO sector. The Australian hospitality sector faces a growing skills shortage and as such industry groups and government aim to fill job shortages with overseas workers (RCA, 2016). This in itself may be reason for attention as research in this area suggests a difference style of curriculum may be required in catering for domestic and international students (Charlesworth, 2008). Research by Barron and Arcodia (2002) suggest career development and retention may also be greatly improved in the industry by adapting to the learning styles of the students. This research, suggesting greater customization of the hospitality's curriculum is further backed by Richardson study (2010) suggesting a significant difference in

hospitality graduates in Australia between domestic and international students. The study suggested that although the majority of international students found the industry offered important career factors, the majority of domestic students indicated they were less likely to join the industry after graduation (Richardson, 2010).

Another important factor from the survey suggested a staggering 97% of all participants had never received any training specific to environmental sustainability. Considering the wide acceptance that the CFS is environmentally unsustainable yet the RFSO sector is reliant on it to survive suggests there are great challenges ahead for the RFSO sector in this area.

6.3 Sustainability Knowledge and Awareness

Analysis of the data revealed an overall response to this set as; 50% correct, 30% in-correct and 20% unsure or a score of 2.3. These questions, viewed as general industry knowledge by the initial sample group were used to identify a general group average of the subject.

Although, due to the nature of the industry a below average result from the general population could be expected, these results represented actors in the RFSO sector and therefore this is perceived as standard industry knowledge for the outlets involved. Ideally having the survey completed by a sample group may have enabled greater identification variances, however with the data at hand initial conclusion suggest there is room for improvement regarding knowledge and awareness.

High negative scores on these industry style standard questions may either be evaluated as poor general sustainability knowledge, inability to comprehend the questions, or a lack of interest in answering the survey correctly. Although these questions were specifically placed at the start to encourage early commitment, analysis of the remainder of the survey suggested a comprehension of other questions and correlation between the survey responses and the audit.

In particular reference to tradewaste (Q12), the RFSO sector is a large contributor to tradewaste, and as such it is not un-reasonable to suggest most staff should know what tradewaste is and how it is managed. Failure to recognise an important waste stream commonly represented in the industry suggests a lack of basic waste stream identification. Specific to the tradewaste question results indicated 40% correct with the

remaining 40% incorrect and 20% unsure, essentially 60% accounting for a wrong answer relative of an important factor in the sector. Worth noting is trade waste fees differ in price dependant on location of the RFSOs, as the participating RFSOs were located under different council boundaries and fees[7]. What may also be of relevance is the difference in tradewaste fees in the two other major cities in Australia, Sydney and Melbourne. As it is widely accepted that hospitality staff have a higher than normal job turnover it may also be reasoned there is a tendency to move between states looking for seasonal work. This would then give support to the suggestion the difference of tradewaste fees and how they are recognised by different councils may influence the value and understanding by RFSO staff.

The research also found the sustainability knowledge and awareness is also impacted by representatives of food companies wrongfully informing the PIC's and staff on the sustainability of their product. Early interviews indicated some food company representatives even sold product to the RFSOs which was a different species and/or from a different country than perceived. These practices can become a challenge in building sustainability knowledge in the RFSO sector as the food representative is the closest many of these PICs and BOH staff will get to the actual products origin.

6.4 Sustainability Behaviour

In the category of sustainability behaviour respondents were asked if they'd witnessed wastage or excess usage for no apparent reason, for a variety of resource streams which included; food, gas, water & electricity. Other questions in this category also enquired on the re-use of materials and supply of eco-friendly containers.

Waste

Results from the survey suggest that waste in the forms of food, energy and water is witnessed across all participating outlets and this is supported by research in the

[7] Tradewaste costs; Brisbane area; 2 applicable councils 1. Quarterly fee: $97.35, 2.: $1.48p/Kl, Gold Coast: $1.05-$1.20p/Kl, 3. Sydney: $2.20 - $3.60p/Kl, 4. Melbourne: start at $0.91p/Kl + charges added dependant on activity, history and location, which can end up costing several thousand dollars per year (GC, 2017., SEW, 2017., SW, 2017., UU, 2017.)

literature review (Gustavsson, et al. 2013; Juvan, et al. 2017; Mudie, et al. 2013; Silvennoinen, et al. 2015).

Although the topic of food waste is gaining greater exposure and more studies the bulk of this new research is focussed on domestic households leaving the hospitality sector unrepresented (Papargyropoulou, et al. 2016). However, this may also suggest there are opportunities for innovation in dealing with these challenges.

The results from the survey suggest participants witnessed food waste in the outlet:

- 5% *consistently*,
- *38% occasionally,*
- 38% *sometimes*,
- *19% never*.

The total amount of actors witnessing some form of food wastage must be cause for concern for any business operator when in reality this figure relates to economic loss witnessed by 81% of all staff involved in the operation of the business.

These facts are also supported by figures from the literature review in which the SRA (2016) reported on average 480gms of food wasted generated per customer and Baldwin et al (2011), suggesting 4-10% of food purchased by a RFSO is wasted before it is even served to a customer. This last finding by Baldwin may hold greater relevance when analysing the waste further into groups as a separate study by Christ et al (2017) suggests. The study divided the streams into 3 categories; food wasted in storage, food wasted during the preparation and cooking process, and food returned uneaten from customer's plates (Christ, et al. 2017). This identification and categorization of food waste stream in an outlets operation may be beneficial to identify specific areas of interest for further research in this field.

Analysis of the data also identified the *never* respondents to be made up of only 16% BOH and the remaining 84% FOH. This data also revealed 60% of this group were managers and 8% were owners/investors. What this then seems to suggest if that although the majority of staff have witnessed food waste (81%) the RFSO management are unaware or not wanting to admit these actions. As management and owners are the main decision makers in the RFSO this result may hold relevance in the economic and environmental management of RFSO operations.

As earlier in this thesis suggests wasted food is wasted money due to lost materials, time and labour, however these results confirm the majority of previous research suggesting food waste is common in the RFSO sector. This equates to an unnecessary economic loss as well as environmental cost and therefore should be identified as an area requiring major attention.

On analysis of the walk-around audit the responses from the surveys were shown to have over-estimated their waste streams. Although research on self-reporting variability and bias in the hospitality sector is difficult to find, other studies on the reliability of self-reporting suggest issues such as emotion and attitude may significantly affect the reliability of data (Leroux, 2012, Lund and Lund, 2011).

Fortunately, as this research is more exploratory in nature, these results only add weight to the importance of encouraging more academic discussion in the RFSO sector.

Energy

Previous research by Mudie et al. (2013) suggest the greatest areas for energy waste in an RFSO may be through electrical appliances, yet in this survey 82% of participants witnessed gas wastage compared to 74% witnessing some type of electricity wastage. One reason for this observed imbalance may be the audible and visual signs these display. Electrical appliances in most cases have an almost imperceptible hum, and unless fitted with an alarm to warn the user of differences identified in its normal operational pattern, excess consumption or wastage of power maybe difficult to discern. In comparison, gas appliances due to their nature, are more easily observed due to the visual blue and yellow flickering flames commonly observed in many kitchens. These same appliances also register on the touch sensory as they often emit heat. Therefore, even though the survey result suggest gas wastage is witnessed 8% more than electricity, unless a power meter is used to identify actual usage, these results can only be used as an exploratory guide.

It may also be worth noting these survey results confirm previous research presented earlier in this thesis indicating electricity overuse in RFSOs may be severely misrepresented.

Water

As the previous literature review identifies water in RFSOs is essential for the operation as it is used in a variety of ways which include cleaning, cooking, consumption and sanitation. Survey results suggest 83% of staff had witnessed water waste with 17% representing those who had not witnessed any type of water waste. As a survey ratings score of 2.5 suggests there are improvement can be made in this area.
In comparison the SP audit score for water was 3.1, suggesting participants may have underestimated their water use. As other studies of commercial kitchens suggest water is used frequently and very rarely recycled (Fusi, et al., 2014, Ma and Ghiselli., 2015) which indicate another area of potential improved efficiency.

6.5 Sustainability Management

In regards to the sustainability management of each outlet participants were asked questions relating to operational practices such as; waste stream management, waste reduction incentive program and food left-overs. As previously mentioned in the literature review sustainability management is an important tool for the future success of RFSOs however may not yet be recognised as such. This became apparent in the overall rating of 3.1 representing this category suggesting sustainability management was the worst performing out of all key criteria. What is worth mentioning is although the sustainability knowledge and awareness rated the best out of all key criteria at 2.3, this is not being transferred across into the field of sustainability management.

6.6 Sustainability Performance review - audit

To support the survey responses in relation to the sustainability performance a walk-around inspection was performed with a corresponding audit. This audit also enabled the researcher to make additional notes of relevance on each outlet to validate the outlets operational traits.

In the instance of water and energy waste the general feedback from the respondents initially consulted in the exploratory research believed there was minimal waste in the sector, although during the interviews and walk-around inspection of businesses many appliances were switched on or at full capacity even though they were not being used.

Some examples of observed unnecessary resource consumption included:

- un-attended gas burners running full volume,
- exhaust hoods operating while no cooking underway,
- taps constantly running while defrosting/thawing foods under them,
- coolroom doors left open for extended periods of time,
- coffee machines left on continuously (24 hrs) to service two four hour (2 x 4hr) shifts,
- dishwashers used for full cycle with partially empty trays,
- combi-ovens left on whilst no service or food preparation underway.

In the case of energy use, this obviously represents a cost to the business, as well as an impact on sustainability and this cost results in no demonstrable economic benefit when the energy is simply wasted.

Energy use is an example of where reducing business costs and environmental impacts are aligned however realization by business operators and acting on these facts are far less common than one would expect. Out of all the participating outlets none displayed any form of energy reduction signage or offered any proof of incentive programs to encourage more effective energy useage, yet research suggests simple strategies and staff involvement can significantly decrease excess resource consumption (Ma and Ghiselli, 2016; Mudie, et al. 2013; Pirani and Arafat. 2016) and this is relevant when designing strategies to remedy this.

Also of note; none of the nine RFSO PIC who participated had a sustainability or environmental management plan in the venues. On walk around observations only two of the nine outlets managed three waste streams; general, oil and mixed recyclables, and only one managed four streams; general, oil, mixed recyclables and cardboard. Although food waste is specific to the RFSO sector the common approach is to discard left-overs and peelings in the general waste stream. Only one out of the nine RFSOs had some type of herb garden and none of the participating RFSOs saved any form of organic waste for composting.

7. Conclusion

As the thesis has identified there are a range of different issues adding to the sustainability of the RFSO sector and innovation and collaboration will be essential in creating viable solutions. A critical analysis on the sustainability performance has identified sustainability can be improved in all areas of the RFSO. Although SPI are used in measuring both economic and environmental objectives in various industries its application is not documented in the hospitality or RFSO sector, where if used comprehensively may be of great benefit.

As a key component identified for its importance in achieving greater SP in the sector, SM must be recognised by educators and operators alike as an integral factor.
As these survey results and past research has indicated, the implementation of sustainability focussed programs and management of staff are essential in achieving high SP. However, the amount and immediate relevance of information on the topic of SP may be preventing action. Therefore, in assessing the SPI to discern which one, if implemented can have the greatest effect for the least amount of effort SM is the best option.

PIC have a responsibility to encourage and manage the sustainability performance of each venue. Developing incentive programs to inspire the reduction of resources can seem a small way to improve SP however more importantly it encourages team behaviour and rewards staff for improving their behaviour. So too does creating opportunities for innovation and encouraging sustainability behaviour in the staffing environment. Examples of improving SM include encouraging innovation of waste stream operations, such as using food tins to hold cutlery at a table, or donating un-repairable kitchen equipment to local art schools. The same can be encouraged for glass jars which may be used by the bar to store various coloured syrups, pickles, preserves or dry product. There are many opportunities for what is currently perceived as waste to add character and savings to RFSOs.

In regards to the future projections of staffing shortages and decreasing skill requirements in the sector, research shows that a change of management styles can have positive impacts. Training management to adopt a more servitude style approach has been suggested can improve retention rates by encouraging greater purpose and job

satisfaction to staff (Brownell, 2010). Training management in sustainability knowledge and awareness can have a flow on effect to the rest of the staff.
Investing in greater on-the-job training may also improve the stigma currently associated with some parts of the sector, enabling greater job prospects after the RFSO sector (Gatling, 2016). Acknowledging the increasing trend towards staff outsourcing (Schniederjans, et al. 2015) and the changing employment standard to more casual positions instead of full-time are essential in managing the industries future success.

Education and training positively influences performance in every industry yet the hospitality industry, and in particular the RFSO struggle to implement this as a priority. Recognising specialization with acceptable remuneration and prioritising staff for promotion that undertake a variety of recognised up-skilling may be the best way forward in this area.

The results of the initial interviews and surveys clearly show there is no recognised sustainability awareness training available in the RFSO and this is concerning when considering the environmental impacts and influences the RFSO has on the CFS and the consumer.

Knowledge, awareness and behaviour of staff is essential in improving the sustainability performance of the RFSO, and as such sustainability programs and induction should be encouraged. There are a variety of opportunities to involve a greater cross pollination of actors throughout the food system which can include scheduled farm visits - talking to farmers/producers, work experience throughout the supply chain and greater customer interaction. The actors that make up the RFSOs influence the consumer and the producer and this gives them a unique opportunity to be on the front line of sustainability in this environment.

As previously discussed the role and influence of the RFSO and its actors are changing, and as such, greater attention may need to focus on the sustainability behaviour, performance and education levels of the main actors of influence. Recognising these ‘food ambassadors’ may offer unique opportunities to teach and inspire consumers on sustainability performance and the many factors entailed. Data collection across a larger

platform should be encouraged, however due to cost this is currently only done by parties with a financial agenda, which has the potential to bias results.

The CFS issues, that is the model heavily reliant on finite resources is unsustainable, needs to be actioned across a variety of levels. Identifying and addressing major influences in this system is an essential requirement to help solve these challenges. Committing to stronger inter-governmental policy, increasing corporate responsibility's and promoting consumer awareness and mitigation programs may all play a growing part in the future food system on the macro level.
As described in the literature review diet plays a big part in food sustainability and adjusting to a diet higher in plant based foods can alleviate some of the environmental impacts of livestock farming. However, it may be as simple as buying or producing what food is required in an effort to waste less food.

The need for global recognition on the economic values of the earth's ecosystem services and goods is long overdue and commitment is urgently required to protect these valuable resources for future generations. By encouraging recognisable and attainable SP management across the RFSO sector environmental impacts on the CFS can be mitigated.

Cardboard, plastic, glass, tin and styrofoam are the most common forms of packaging supplied to the RFSO although again there are difficulties in getting access to accurate waste data. One of several exceptions, a recent small scale research in Italy on restaurant waste generation showed total waste to consist of: 28.2% food, 22.6% glass, 19.1% paper/cardboard and 17.1% plastic (Tatàno, et al. 2017). While from a sustainably perspective the researchers experience confirms there are still many RFSOs that operate mindful of only one waste stream - general waste.

Although it would be preferred for all RFSOs to manage the various waste streams individually research suggests one or more of the following are contributing factors;

- lack of regular bin collections,
- cheap waste levies not discouraging general waste,
- lack of policy encouraging resource recovery.

Recycle and material reuse programs may be a step forward from general waste patterns however these strategies may need government support to be successful. In Queensland for example, the state currently has no waste levy and the cheapest landfill disposal rate of any state in Australia at $30 per tonne, whereas over the border in New South Wales, state wide recycling program adopted by their state government charges up to $133 p/t (Ritchie, 2016). The same report, investigating the state of waste in Australia, also suggest there may be as many as 2000 unregulated and unregistered landfill sites throughout Australia.

Depending on the region general waste is sent to landfill or incinerated, however statistics from the Sustainable Restaurant Association in the UK suggest up to 80% of all general waste discarded in the hospitality sector may be able to be re-cycled in some form (RSA, 2016). Although many recognised anti-waste slogans commonly advocate the; re-use, recycle and re-think policy, it may be due to food safety measures and cheapness of materials this is not a major consideration in the RFSO sector.

7.1 Potential solutions

As the old proverb states “Necessity is the mother of invention”, and it may not be until the sustainability of RFSOs hits crisis point, where businesses are enforced to take greater responsibility for the environmental impact of their menu’s, buildings and other outputs, and PIC are required to invest more in the education and upskilling of their staff, that the sustainability performance of RFSOs becomes a more serious topic.

Government regulation in the form of legislation and taxes can change public behaviour, however Australia and in particular Queensland are yet to adopt policies requiring greater accountability for the environmental impacts of the RFSOs and all businesses in their supply chain.

Although government interaction can help achieve greater sustainability on a large scale social enterprise and community movements have more success on a grass-roots level. These innovations can be in the form of food rescuers, compost collections, and even community gardens used to educate RFSO staff.

On a more micro level an incentive style scheme attempting to minimize resource usage in RFSOs can prove successful. Management can offer staff a percentage of what the RFSO saves from their projected energy and water bills which can have a positive effect

not only on resource reduction but also may impact team camaraderie and group behaviour.

Organic waste can easily be sorted from the various waste streams and either composted or used for a worm farm. Vegetable scraps, paper, coffee grounds and tea can all be re-directed into valuable nutrients and energy for an onsite garden and require minimal financial input to start-up, if any.

The social benefits of gardening are widely accepted and a vegetable and/or herb garden may show to have a positive impact on team performance. Growing, planting and tending to gardens can give many staff their first experience in growing, harvesting and eating or serving food they have harvested to customers. Encouraging attachment to the natural food system and its various cycles for both staff and customers may also inspire greater appreciation of the bigger food system, resulting in less waste and potentially having them become greater advocates for the RFSO sector.

Therefore, it is fair to conclude; until sustainability performance is recognised by the industry as fundamental in managing operations more effectively throughout the RFSOs resources cycle the industry will remain unsustainable and inefficient.

7.2 Further research

This thesis represents initial research into the sustainability performance of RFSOs and identifies a variety of challenges, which if left unmanaged will have increasing negative consequences. Some of the major challenges requiring attention include:

- a current hospitality model that encourages growth and excess consumption,
- a reduction in the education level of staff required for skilled roles,
- a highly competitive industry not used to sharing knowledge and resources, and
- a growing trend from consumers demanding greater customization of menus.

As noted there are many opportunities to continue this research however time, scope and resources are a major limiting factor. More comprehensive research into the sustainability performance program as well as attempting a greater collection of quantitative data using the sustainability performance indicators is recommended.

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9. Appendix (A)

A 1. Initial survey – Exploratory research

This questionnaire is solely for research purposes, requiring voluntary participation, to identify eco-efficiencies in the hospitality industry. The data collected will be used in the strictest confidence and comply with all relevant ethical standards.
We ask all participants to please answer each question to the best of their ability to encourage an accurate assessment.
(For privacy purposes do not add your name or business name).

1) Which best describes your sector:
1) Restaurant/ café
2) Fast food/ take-away
3) Fast food/ take-away
4) Other

2) What best describes your position in the RFSO:
1) Front of house (manager/waitstaff/cashier/barperson/server)
2) Back of house (chef/cook/apprentice/kitchenhand/porter)
3) Supply chain (production/transport/storage/distribution)
4) Business owner/investor
5) Other

3) The age group you fit into:
1) 16-23
2) 24-31
3) 32-39
4) 40-47
5) 48+

4) You are best described as:
1) Male
2) Female

5) How many years since you last studied at a recognised training organisation (High School, TAFE, University):
1) 1-5
2) 6-10
3) 11-15
4) 16-20+

6) How many years have you worked in the RFSO industry:
1) 1-5
2) 6-10
3) 11-15
4) 16-20+

7) How long have you worked in this specific business for:
1) Less than 6 months
2) 6 months – 1 year
3) 1 – 2 years
4) 2 - 5 years
5) Over 5 years

8) Greater understanding of the environmental impacts of the current food system is needed in the RFSO industry:
1) Strongly agree

1

A 1. Initial survey – Exploratory research

2) Agree
3) Neither agree nor disagree
4) Disagree
5) Strongly disagree

9) The design of our menu (food ingredients) can have an influence on the social and environmental health of the local region:
1) Strongly agree
2) Agree
3) Neither agree nor disagree
4) Disagree
5) Strongly disagree

10) Food supply transparency, green/eco labels and environmental certification are important steps for food sustainability:
1) Strongly agree
2) Agree
3) Neither agree nor disagree
4) Disagree
5) Strongly disagree

11) There has been occasions at work where If I had more time I could have wasted less food:
1) Strongly agree
2) Agree
3) Neither agree nor disagree
4) Disagree
5) Strongly disagree

12) I am willing to pay more for food if it has a positive environmental impact:
1) Strongly agree
2) Agree
3) Neither agree nor disagree
4) Disagree
5) Strongly disagree

13) There are many ways in which my workplace can be less environmentally damaging:
1) Strongly agree
2) Agree
3) Neither agree nor disagree
4) Disagree
5) Strongly disagree

14) There is not enough education on the environmental impacts of food in the RFSO industry:
1) Strongly agree
2) Agree
3) Neither agree nor disagree
4) Disagree
5) Strongly disagree

15) I would participate in a program that could lessen our RFSO environmental impacts:
1) Strongly agree

2

A 1. Initial survey – Exploratory research

2) Agree
3) Neither agree nor disagree
4) Disagree
5) Strongly disagree

16) If a RFSO grew a portion of their fresh produce they would place greater value on all food:
1) Strongly agree
2) Agree
3) Neither agree nor disagree
4) Disagree
5) Strongly disagree

17) My RFSO recycles organic waste into compost or a worm farm:
1) True
2) False
3) Unsure

18) My RFSO uses a local food co-operative and/or mainly local produce and drinks:
1) True
2) False
3) Unsure

19) My RFSO recycles/redirects how many separate streams of waste: (e.g.: Cardboard - Paper - Glass - Plastics - Organics – General)
1) None
2) 1 to 3
3) 4 to 5
4) More than 5

20) I am too busy at work to think about resource conservation and waste minimization, that is the manager's job:
1) True
2) False

21) The most common material I recycle at work is:
1) Plastic
2) Cardboard
3) Food waste
4) Metal & wood
5) Paper

22) I would love to know more about my foods footprint (inputs of water, energy, chemicals, output impacts and social story) but the information is hard to find:
23) Yes
24) No
25) Unsure

23) To improve our RFSO environmental impact I would be prepared to work how many free minutes every day:
1) None
2) Upto 2 minutes
3) Between 2 and 5 minutes
4) More that 5 minutes

3

A 1. Initial survey – Exploratory research

24) Would you use an eco-food label system that highlighted each products point of origin & environmental rating:
1) Yes
3) No
4) Unsure

25) Recycling 100% of kitchen waste (closed loop system) is not possible in our RFSO:
1) True
2) False
3) Unsure of what a closed loop system is

26) I would take part in regular industry specific up-skilling/education if it were available:
1) Once a year
2) Twice a year
3) More than twice a year
4) Less than once a year
5) Never

27) I'm confident in my knowledge of the current food system to be an ambassador for the hospitality sector:
1) Strongly agree
2) Agree
3) Neither agree nor disagree
4) Disagree
5) Strongly disagree

28) RFSO can play an important part in connecting people in urban life to the natural environment:
1) Strongly agree
2) Agree
3) Neither agree nor disagree
4) Disagree
5) Strongly disagree

.....Thank-you for your time.....

4

A 2. Initial survey participation request

A 3. Sustainability Performance - Terms of Reference

Terms of Reference

For the

Sustainability Performance Program (SPP)

Industry specific for

Retail Food Service Outlets (RFSO)

_ Hospitality _

This Term of Reference (TOR) has been specifically developed for all hospitality staff in the retail food service outlet (RFSO) sector.
This work is part of an unsponsored university research project attempting to identify sustainability performance in the sector.

This TOR has been developed to highlight some relevant topics in the use of resources required in hospitality operations and can be used to assist in sustainability management, in the staff orientation process, or offered as a reference tool to assist in menu planning and product purchasing.

The objective of this TOR is to increase awareness on the environmental sustainability of the RFSOs by its stewards, and encourage greater sustainability performance and awareness of resource consumption.

Introduction to the terms of reference

Food is an essential part of life; we all need it to survive, however with:

- a population of an extra 2 Billion people predicted by 2050 (9Billion);
- an increase in protein rich diets globally (China alone doubled meat consumption in the last 20years);
- fresh water shortages; and,
- some peak fuel limits reached,

the Food and Agricultural Organization of the United Nations (FAO) states food production needs to increase by 70% if we are to feed the population.

Food production is one of the greatest environmental impactors in the world today, and due to the hospitality industry's' heavily reliance on its many products, decisions in your everyday work practice can influence these impacts.

Figures suggest over 30% of food is lost or wasted around the globe which can cause unnecessary consumption and disruption of resources and services. Some examples of these include:

- Fresh water use (Australian farms increased 32% 2012-2013)
- Energy overuse (burning of fossil fuels for fertilizer production, transport, processing),
- Natural and synthetic fertilizers and pesticides over application (accountable for destruction of biodiversity),
- Social capital (small farms cannot compete with large and mechanized mono-cropping systems),
- Packaging over use (unnecessary boxes, cartons and synthetic wrapping materials),
- Pollution (excess waste in landfill can create air, water and land contamination).

Environmental impacts in the industry add up yet can come from a variety of smaller actions, from; leaving the gas burners on when not required to throwing the cardboard into the garbage bin instead of recycling, designing a restaurant without a garden or buying cheap imported products from an un-recognized source.
This paper attempts to highlight a few relevant industry challenges with the aim to encourage:

- better awareness of the current food system,
- greater understanding of environmental management practices, and
- greater responsibility of product stewardship for the planets natural resources.

Carrying capacity

Carrying capacity is fairly simple in volumous terms when speaking about the volume of a bucket or a measuring cup. However, when it refers to the environment many other influences need to be taken into account in an attempt to address this. Humans are reliant on earth's natural services to survive. Essentially we need fresh water, clean air, healthy soil and a healthy ecosystem to manage the many inputs we expose it to. Synthetics and pollutions from fossil fuels are one of the limiting factors when it comes to carrying capacity for the earth. Currently the population is at 7.2 Billion, and projected to reach 9 Billion+ by 2050. Notable research estimates we have exceeded our ability to feed ourselves naturally and the earths maximum natural carrying capacity is 3.2 Billion people. Given we are now requiring more resources now than ever and exploiting many of the earth's natural systems to meet the growing demand, there may be good reason to argue carrying capacity is one of the most important subjects for future leaders.

Cost

There is an old saying: the quickest way to make money is to save it, and this can be very relevant in the RFSO.

There are many reasons to reduce resource consumption, shop ethically and work more creatively, however the main influence from a business point of view is cost. Studies in UK show electricity can be saved on average 40%-70% in commercial kitchens, and a study in China showed a 50% reduction in water consumption can be achieved through changing tap heads and pre-soaking dishes. Investing in re-useable delivery tubs for all produce may cost an initial fee, however the money saved through limiting rubbish collection and the good will generated in the community for being eco-active may pay dividends.

Money can be made by saving it, and there are a multitude of ways money can be saved in a RFSO.

Eco-system services

Ecosystem services are critical for human life yet often get minimal consideration when equating food cost. All the earth's natural resources that we use are eco-system service

(ESS). From wind currents which carry rain and pollen to solar which heats the earth and enable photosynthesis to occur, all of these are essential for life on earth. The water cycle filters and replenishes fresh water for drinking and agriculture, insects and birds pollinate crops for food and bacteria helps break down waste for nutrient recycling. The carbon cycle, nitrogen cycle and nutrient cycles are some of many natural cycles which are all essential ESS, enabling life on earth. Our use of ESS are endless, although unfortunately they have never been an essential factor in the food systems costing. Putting an economic figure on a common good is a difficult task, however due to the global population inflicting serious environmental damage through land-clearing, over-consumption, over-harvesting and excess chemical usage, the ESS needs greater valuation to become sustainable.

Electricity

Electricity has been cleverly branded as the clean energy, easy for the consumer to flick a switch and have instant access to power, seemingly without any exhaust or by-product. However, the story of electricity more commonly starts at a coalmine several hundred if not thousands of miles away. The coal is mined, quarried and cleaned, then transported to a power station, where typically the coal is burnt to heat massive steam turbines, which then generate electricity for sub-stations to transform the power throughout the grid. Alternatively coal seam gas (CSG) is forced to the surface by water pumped down wells which are drilled into coal seams. Large amounts of water are required for this action, which also results in contaminating the water with chemicals and heavy metals, pumped into evaporation ponds, to be disposed of at a later date. Unfortunately, there is still no way to re-value/re-utelize this by-product/chemical sludge which can have devastating effect if leached into water ways.

So although the concept of electricity may initially seem clean at flick of the switch, unless the electricity is coming from solar or another type of renewable energy source, the energy used is creating pollution at the source.

Electricity is becoming more prevalent in the RFSO. Refrigeration, lighting, heating/cooling, cooking, computers are widely used in most RFSO however minimal attention is directed to the correct management of it.

Energy

Energy is used in all stages of the foods cycle and can vary greatly depending on what type of system is used. Fuel for tractors to plant rows of crops, energy for the artificial fertilizer to 'fix' chemicals for plant use, gas for the turbines to refrigerate and light the abattoirs and diesel to power the trawlers to harvest the fish. Energy is used in the production of food, the packaging of food and the transportation and storage of food.

Externalities

Externalities are costs or consequences affecting a third party not factored into the original equation, or more simply put, an unconsidered action existing because of the original action. There can be positive or negative externalities, depending on the impact. Used in economics to describe the cost to an un-related third party, negative externalities can occur in food production when the cost of the natural environment and natural resources are not factored into the economic equation. Some examples may include the downstream pollution of wetland habitats not factored into a feedlots waste discharge costs or the environmental impacts excessive fertilizer run-off may have on a fragile marine parks essential for nursery habitat of commercial species.

Feedlots

As the name suggests, the purpose of a feedlot is to feed an animal, typically to greatly increase body mass, before an animal is slaughtered. Due to the economic model approach of the food system, many animals are treated as a commodity, their sole purpose to earn the biggest amount of money for shareholders in the shortest amount of time. This may mean animals in captivity can be fed more food than natural their natural habitat would allow whilst being restricted in their movement. This act encourages greater growth rates, resulting in a quicker turnaround of the animal from birth to slaughter. Unfortunately to feed an animal in a restricted environment creates other challenges, most notably animal health, feed and waste.

For many years' growth promotants have been used in the diets of many animals deemed fit for human consumption, to increase size and growth rate. Antibiotics has also been used, not only to prevent and treat illness among the captive animals, but it was discovered, large doses also act as a growth promotant. Although some figures suggest the agricultural industry is responsible for 70% of pharmaceuticals produced globally, this practice is allegedly declining due to consumer demand and policy changes.

Growing large amounts of plants required for feed also creates its own challenges including damage to fragile ecosystems from land clearing and destroying species diversity by growing huge single (mono)crops treated with excess fertilizers and pesticides.
Feedlots may seem an economically efficient way of growing meat (hence the word factory farming), however the concentrated waste from manures and abattoirs add to the growing problems for the ecosystems which support them.

Fertilizers – Pesticides – Herbicides

In agro-industrial farming crops are commonly given doses of synthetic fertilizer which require large amounts of energy to create. As a natural cycle, the Nitrogen cycle is one of the most important biogeochemical process required for life (as Nitrogen is essential in the building blocks/amino acids of life). Plants can only fix a certain amount of natural nitrogen and this was always the limiting factor in growing crops for a growing population. However, in 1908 a German chemist, Fritz Haber revolutionized this process of artificial nitrogen fixation, by passing air through a powerful arc of electricity (copying the way this process happens in nature, lightning). Although his invention has been partly credited with feeding an extra 3Billion people the excess use and over-application of it has created environmental problems which were not foreseen.
The build-up of these excess nutrients from fertilizers can create environmental problems. Not only can they destroy soil health by killing precious microbes in the soil, when this excess reaches a waterway/river/ocean, the nutrients can over fertilize the water creating a sudden bloom of algae which then starves the water of oxygen. This is termed eutrophication and can have long lasting environmental effect both to the immediate and surrounding plant and animal life.
In attempts to discover solutions recent studies comparing organic compost versus synthetic chemicals showed greater soil microbes, healthier plant matter and an increase in local biodiversity from the natural compost product. Although this type of fertilizing is not new there are some questions regarding the ability to revert back to compost only farming to feed the growing population.

Synthetic fertilizers, pesticides, fungicides are potentially damaging to human health and the environment. Nano-particles (scientifically developed particles so small they can be absorbed through the skin or uptaken by the root system of plants) are now used in many

types of agricultural applications even though the long term effects are still not understood. Synthetic pesticides have been linked to a variety of pollinator deaths including, bee's birds and other insects. Bee's, essential to pollinate 70% of the planets food crops are being effected by chemicals used on a variety of crops to an extent many countries are have already banned certain products.

Food life cycle

The life-cycle of food involves the cradle-to-grave approach. The food is germinated/ begins gestation phase, sprouts/ is born, reared/ grown, harvested/slaughtered, processed, packaged, transported, stored, consumed, passed as waste, treated and returned to earth. All steps in the life-cycle for a specific food should be recognised including primary production, processing, packaging, storage, transport, distribution, preparation, consumption and waste.

Food miles

Food miles is the term used to represent the distance that agricultural products travel from their original location to the consumer. Although there is some concern that the method is potentially misleading as it does not take into account other environmental impacts of food production (Rama and Lawrence, 2008) it may be a useful tool in recognising the products origin (Kissinger, 2012) as well as measuring the carbon emissions from the transport vehicles.

Many foods travel thousands of miles from production to processing to consumer and an example can include Peru, supplying over 80% of the worlds Asparagus. In the instance of Australia, this represents a journey of roughly 15,000 kilometers for a 'fresh' food item, often competing against local products. Due to trade agreements, tariffs and market incentives many national producers cannot compete with the cost of imported items. Australia's uniquely remote location means many other food stuffs that are imported here travel vast distances over long periods of time. Over 80% of all Australian pork products and over 65% of all its seafood is imported from other countries. This not only adds to the pollution of food miles from travel, but also the energy, storage and chemicals required to keep this produce 'fresh' for market.

Food sustainability

Although there is no universally agreed definition of what food sustainability is, traditionally it is explained as: ensuring that future generations may grow/harvest/produce the same amount of food for the same (or less) amount of effort indefinitely, whilst reducing the environmental impact. Food sustainability includes all the actors in the food chain including; primary producers, transporters, packers, wholesalers, retailers, RFSOs, consumers & disposers of waste, all working under the guiding principles of environmental, economic and social balance.

Gas

Currently the most common form of energy used for cooking in commercial kitchens is gas. Natural gas and liquid petroleum (LP), is used to power many large cooking appliances such as ovens, hot-water systems and stovetops, although there is a trend for more electric powered ranges, mainly due to its more precise heating capabilities and perceived safety. Although coal is still the main fuel to power generators of large power stations in some parts of Australia, Western Australia's main source is natural gas from offshore drilling and Queensland is predominantly CSG from the Bowen and Surat Basins. The environmental impact/potential impact resulting from the extraction methods of any fossil fuel should warrant further research. Damaged ancient aquifers, chemical pollution from the extraction phase and dropping water tables from excess water use should be measured against the importance of fresh water and its value to agriculture and human habitat. Australia is the driest inhabitable continent on earth and as such more consideration should go into how the gas is extracted and from what area.

GM (Genetically Modified)

GM stands for genetically modified or engineered to specifications. This may include the design of biological pesticides to occur inside the growing plant to prevent insect attacks, separating drought resistant characteristics for dry climates or extending lactation capacity in dairy cows to increase milk production.

Depending on the developer, some plants that are GM are designed to require input of certain chemicals to maximize yield crop. It is reported that 90% of the world's soy production is GM and in the United States 88% corn, 94% of cotton seed and 90% of the cotton seed is GM.

Although there may be many arguments for and against GM food and the benefits to food security, concerns over GM interacting with the natural environment are growing.
GM salmon escaping and breeding with natural salmon or GM plant strains cross breeding with heirloom varieties can have long reaching consequences on the food system. As yet much of this technology has not been around long enough to gather sufficient scientific data, there is also discussion that a minimum requirement should be the educating of consumers regarding potential human and environmental health effects.

Retail Food Service Outlets (RFSO)

RFSO includes all food outlets which serve consumers/customers food from primary/secondary producers, which has required skilled staff to transform the basic/raw product into a ready-to-eat meal. RFSO includes cafes, restaurants, clubs, hotels, canteens, take-away food shops, food trucks and other retail food outlets serving a ready-to-eat meal. RFSO falls under the hospitality and tourism sector although does not include venue's where food is bulk produced in a specialized location and transported and includes; event style venues, hospitals, schools, prisons, etc.

RFSO environmental impacts

Environmental impacts from RFSO initially start in the construction phase of the business. Recycled, re-useable and long life building materials (examples of wood or recycled plastics, shipping containers) versus materials that are single use and require energy to manufacture and dispose of (concrete, steel, some paints, single use plastics).
Consideration should also be given to lighting, heating/cooling, cooking equipment, waste and the impact the outlets footprint will have on the surrounding environment. The building should be designed using the natural attributes of the location (e.g.: directional - facing sun, prevailing winds, natural vegetation buffer) to improve cooling/heating/ lighting of the site.
Operational RFSO need to be mindful of the impact the consumable resources have on the environment. Gas and electricity use can be minimized using improved management strategies including regularly servicing equipment, water re-use and water capture.
Waste materials can increase damage to the environment if not managed effectively. Cardboard, paper, glass, plastics and cooking oils should be re-used or recycled instead of disposed in landfill with general waste.

The non-degradable cleaning chemicals for floors, benches, exhaust hoods, grills and crockery are typically disposed of down the drain increasing water treatment and potential infrastructure damage. Changing chemicals to eco-friendly solutions, re-using delivery tubs, developing waste management programs, adopting incentives for re-fillable coffee cups and creating a compost or worm farms are just some ways to help combat the negative environmental impacts.

Packaging

Arguably the most difficult waste to dispose of in the RFSO is the packaging. Traditionally most packaging was re-used. Jars would be re-filled, wooden boxes would be re-used and the only excess would be paper which was then re-used in composting. With today's efficiencies in technology new materials are being created making packaging one of the greatest challenges in the food cycle. If managed properly cardboard boxes and plastic wrapping may seem easy to recycle, but unfortunately there is a large increase in combination compounds which makes the ability to recycle a product economical unviable due to the difficulty in separating the materials. Multifunctional materials designed to package food for quality, hygiene and safety during transportation can create environmental problems post-consumer. Synthetic compounds are difficult to dispose of and can remain in the environment for hundreds and even thousands of years, and many wholesale type foods now wrap individual portions in plastic wrap, housed inside plastic cartons.

Although this is a growing concern there may be some positive in the trend to make eco-friendly packaging. Recent research shows consumers prefer packaging from more natural eco-friendly products, however the challenge is that many of those do not want to pay any extra for it.

Primary food production

Primary food production encapsulates all food that in the initial stage of the food cycle and is best described as: " growing, raising, cultivating, picking, harvesting, collecting or catching food" (NT, 2016).

Animal farming, agriculture and fisheries are all forms of primary production, however once food is processed it is known as either secondary or processed.

Produce storage

Although it may seem all fresh produce, meats and fishes are harvested continuously, in many instances this is not the case. Due to technology and science apples can be stored in managed atmospheres for up to a year, and in the case of many bananas they are often picked and packed hard and green, and once at the end destination, gassed and heated to the preferred ripe stage. Unfortunately, the supermarkets and the consumer has dictated the terms to the producers, demanding out of season produce all year round, and as a result genes are favoured more for their storage capabilities rather that their flavor and nutrition.

It is not uncommon for most cities to have giant warehouses of food either frozen, chilled or dry, to supply the demand. Depending on the freezer effectiveness many pastry, meats and seafood items have been known to be safe and edible up-to a year.

Sustainability - the 3 pillars

The three pillars of sustainability are environmental, social and economic, and for all to benefit equally its important these all in balance.

It may be reasoned global business has evolved with the main emphasis on economics and minimal concern for the other two pillars. The economic model was designed to support a linear theory, where growth was good and seemingly exponential.

In the modern world this model does not work, and circumstances are now showing us this model has to be brought back into balance within the limits of the eco-system services.

The CFS is recognized as an agri-industrial system. This means it uses industrial processes of mechanical, economical and chemical principals to manage natural systems.

As the global population grows the increasing impacts from this industry on the natural environment are becoming more widely observed, and of the more importance it is to re-balance the three pillars of sustainability.

Although for many years the many different inputs that effect each cycle has been understood, it may take a serious catastrophe for the worlds governments and corporations to unite and act as one on this serious issue.

Sustainable foods

Sustainable food is food that is grown/harvested/reared/produced within the limits of nature's boundaries with major environmental consideration, and include foods that;

- are harvested within the season specific to the natural cycle of the species,
- are not grown using un-renewable resources,
- have minimal distance travelled (traditionally fossil fuels are used in transportation, storage and packaging which impact the natural environment, as well as excluding small farm holders in favour of large corporations),
- are geographically and seasonally specific (which may involve preservation methods for yields to be used out of season and location),
- incorporate endemic species consisting of native/bush foods,
- should also encourage the consumption of invasive/pest species,
- do not require synthetic inputs for growth or prevention of pests.

Plant based food

Should:

- not require synthetic fertilizers or pesticides,
- not be genetically engineered (for chemical dependence/resistance),
- not consist of a mono-crop (be part of multi-crop system),
- grow in a geographically specific location with minimal intervention, (seasonal/regional), and,
- have minimal impact on the surrounding environment (encourage biodiversity).

Marine based food:

Should:

- be caught/harvested respecting the natural migration and growth cycles of the species,
- allow all by-catch species to be used,
- be caught/harvested using equipment that allows a protected species to escape, and,
- be caught/produced using methods which have minimal (if any) impact on the environment (eg: energy/fuels/pollution/ghost nets/toxic paints/chemicals/dredging).

Land based food animals:

Should:

- be free to forage on land that replicates the nutritional load and geographic location of the specific species,
- not be given pharmaceuticals (unless sick),
- be stocked in densities that enable them to roam and exhibit their natural behaviour, and,
- be slaughtered and prepared in an ethical and humanely manner.

Un-sustainable food

Un-sustainable food is food that depletes or diminishes the capacity of the earth's ecosystems to support life (SAFA, 2016). An example of food which is unsustainable would be fish that are caught before they've reached reproductive maturity, or plants are harvested before they've had time to disperse their seed. Unsustainable food can also mean targeting one specific species for too long, instead of allowing a harvesting of a variety of species

Un-sustainable food can also include mass production of a single species, driven by economic objectives, and not accounting for the true value of the natural resources impacted (externalities).

Negative environmental impacts of food

Although modern civilization has evolved to this point because of the many innovative achievements there are influences in the foods life-cycle which can contribute to negative environmental impacts.

Some points that may require attention are:

- Overuse of synthetic and chemical products and outdated farming/harvesting methods which can damage fragile eco-systems,
- Mono-crop or single crop farming; increases the risk of pest plagues by un-balancing the natural eco-system as well as requiring large amounts of fossil fuels for production,
- Intensive rearing of animals; requires huge amounts of cereal products and pharmaceuticals, as well creating large amounts of effluent that cannot be processed in the natural cycle,
- Large amounts of effluent can create environmental damage of soils, water and air resulting in long-term destruction of natural environments,

- Fishing/harvesting a species faster than it can reproduce; can collapse a fishery and cause a devastating roll-on effect,
- Discarded fishing equipment (ghost nets, long lines, pots, etc.) and chemicals used to clean and/or paint vessels; can cause devastating effect on marine life,
- Land clearing and the destruction of forests (for animal and crops); can result in habitat loss and contribute to the loss of essential nutrient rich top soil resulting in soil erosion and encourage flooding in times of excess rain,
- Large scale cropping/rearing in water scarce regions; can deplete fresh water tables resulting in desertification,
- Mismanagement of feed, waste & stocking in aquaculture; can disrupt or destroy surrounding natural eco-systems,
- Processing and packaging; excessive use of plastic and non-reusable transport and storage packaging,
- Processing plants/ abattoirs; use huge amounts of energy in refrigeration, frequent steam cleaning, treatment of waste as well as potentially cause noise, odour, water and solid waste pollution,

The modern agri-industrial food system has an impact in every stage of the supply chain, however with consumer awareness and positive action, industry may adopt less damaging processes to lessen some of these impacts.

Waste

Although in a natural cycle there is no waste, everything has a function and use, modern methods of food production have created a massive market of waste. The manure from a cow in a traditional small scale farm environment, which would naturally go into the next phase of the nutrient cycle, into the earth as fertilizer for plants to grow, is now caught is massive waste ponds in feedlot operations where the animal is confined to a small space. Due to the high volume and concentration of minerals and compounds of this waste the natural cycle cannot break these down in a short-time time and they become a serious threat to the environment. In some instances, effluent is sprayed across the landscape in an attempt to dilute it with the land, however as the natural cycle may not keep up with quantity, it remains until rains wash it into the waterways, creating more damaging problems.

Waste comes in many forms, however traditionally waste was managed as the energy to catch/produce/harvest was so great that it was inefficient to waste any part/ material of a product. Everything had a use and it was common to take containers to the store or markets to be re-filled. Today materials are produced at such cheap prices that saving them, washing them out and re-using can seem cost prohibitive. However, everything has an environmental and social cost as well as an economic cost and these are now recognised as essential elements to include when planning for the sustainability of a business.

Due to technological and engineering advancements machines were developed to outperform manual labour with the only real visible cost being cheap fuel. Efficiencies in the supply chain from cheap fuel enabled growth of the food system on an industrial scale. The main focus of efficiencies was in the production side and waste was viewed as a valueless by-product. Unfortunately, this has created a system where eco-system services (natural resources of fresh water cycle, air, soil) have not been given a realistic economic value in the equation, resulting in a highly unbalanced and financially biased system.

The topic of waste needs urgent attention. Products that are discarded without thought may in fact have another use instead of contributing to landfill.

Water

Water is essential in the development of food and figures suggest that 60% of all water use in Australia is required for food production (Lenzen and Foran, 2001) and yet uoto 28% of this water is wasted through food waste and loss.

Water is essential in the operation of an RFSO from washing and cleaning to cooking food and growing produce. Water management strategies are important for any food related business and essential in understanding the understanding the full environmental impact of a business.

In many RFSO water is wasted; from hosing floors instead of mopping, thawing frozen product under taps to speed the process and sending trays through the dishwasher without being full. Water can be saved and re-used in many forms throughout the RFSO and innovation in this area will gain importance in the future.

End note

Although the earth's natural resources replenish and refresh themselves in cycles, sometimes these acts may take thousands, hundreds of thousands or even millions of

years to complete. Some suggest advancements in technology and processes have allowed mankind to prosper on an unsustainable scale, and the earths ecosystem services are compromised in breaking-down these compounds. Radioactive waste from nuclear power stations, nano-particles in the agriculture/aquaculture or even gases used in refrigeration can cause environmental damage tens of thousands of years into the future.
Being more aware of the inputs and outputs of your business in the environment can have an impact.
Asking the questions; how many actors in the food chain, where exactly does your food comes from, who producers your food, can the package be reduced/recycled, can you buy a similar product sourced from nearby, are all question those in the food service sector have the responsibility to ask.

Team bonding exercises to meet with one farmer/primary producer each month may be a positive goal for the business. Building rapport with the various actors in the foods life-cycle creates greater transparency and accountability in the system.
Plan a course of action to encourage sustainability performance in your business.
Talk to suppliers, growers, producers, pickers and start to recognise the role that you and them play in the future of food security.
Traditionally suppliers may try to sell products cheaper, or shelf stable products, or encourage you to buy a certain product that may not have an ethical story. Find the story of the food and convey this story to the customer. By arming the customer with this information research shows they will be prepared to pay more and be more loyal.

Respecting your food and the role you play in the RFSO sector can have positive results on the natural system tomorrow and into the future.

Useful reference sites for further information

Australian bureau of statistics, Land:
http://www.abs.gov.au/ausstats/abs@.nsf/lookup/bysubject/1370.0~2010~chapter~land references %286.2.7%29

Australian bureau of statistics, café & restaurant: http://www.abs.gov.au/ausstats/abs@.nsf/latestproducts/8655.0main%20features32006-07?opendocument&tabname=summary&prodno=8655.0&issue=2006-07&num=&view#EMPLOYMENT

Australian bureau of statistics - Water use on Australian farms 2013 – 2014: http://www.abs.gov.au/ausstats/abs@.nsf/mf/4618.0

Australian egg corporation limited, industry statistics: https://www.aecl.org/resources/industry-statistics/

Betty Crocker; the history of kitchen: http://www.pbs.org/food/the-history-kitchen/who-was-betty-crocker/

FAOSTAT, 2016, Food and agriculture organization of the united nations, statistics division: http://faostat3.fao.org/download/o/oa/e

Northern Territory Consolidated Acts, Food acts: http://www.austlii.edu.au/au/legis/nt/consol_act/fa57/s9.html

FAO. UN. Sustainability Assessment of Food and Agricultural Systems: http://www.fao.org/nr/sustainability/sustainability-assessments-safa/en/

U.S census, 2015, United states census bureau, World population data, accessed: http://www.census.gov/population/international/data/worldpop/table_population.php

WTO, 2015, World trade organization, statistics, country profile, accessed: http://stat.wto.org/countryprofile/wsdbcountrypfview.aspx?language=e&country=br

Basic Information about Food Waste: http://www.epa.gov/osw/conserve/materials/organics/food/fd-basic.htm
http://www.wastedfood.com/2011/05/12/fao-report/
https://www.environment.gov.au/protection/national-waste-policy/publications/national-food-waste-assessment-final-report

A 4. Waste trial participation information – (P1) (a)

RFSO/ Hospitality Waste data collection

Retail Food Service Outlet Waste Data Collection
Mr Simon Grigalius, Master of Arts Research Candidate, Bond University.
2016

Thank you for agreeing to participate in this waste data collection research which aims to add value to the hospitality/ retail food service outlets (RFSO) sector.

- This is a bag or bin observational measurement only and does not require weighing garbage on kitchen scales or sorting of waste by hand.
- The research consists of two (2) separate data collection periods of one week (7 days) each measuring individual waste streams. The waste measurements of all solid and oil type waste are required to be recorded each day for the survey period. The number of customers served during this same time frame is also requested.

Your business waste is to be recorded from observational measurements for a pre-selected 7-day period using up-to 5 individual streams consisting of:

- General waste (G) - to be measured in a normal 75 litre garbage bin.
- Recycled waste (W) - to be measured in a standard 240 litre 'wheelie' bin,
- Cardboard waste (C)- to be measured in a standard 240 litre 'wheelie' bin,
- Oils and fats (O) – to be measured in 20 litre amounts,
- Saved food (S) – to be measured by kg on pick-up, and
- Customers (P) – in relation to every standard meal sold.

General waste (G) is all waste that is not discarded in the following streams. It is reasoned the standard 75 litre kitchen bin is the most common method of waste collection currently used, however if a different volume bin is used, it is important to note this.
In some instances, cardboard (C) is recycled and collected in a wire cage, therefore an estimation should be used against the capacity of a 240liter 'wheelie' bin.
Miscellaneous recyclables including plastic/glass/tin/paper materials (W) are to be measured using the wheelie bin measurement.
Cooking oil (O) and other liquid and grease waste are to be measured in a 20litre drum/tub.
Food savers/rescuers (Food Bank, OzHarvest, etc) (S) are to measured in kilograms (kg).

simon.grigalius@student.bond.edu.au

Waste trial participation information (P1) (b)

RFSO/ Hospitality Waste data collection

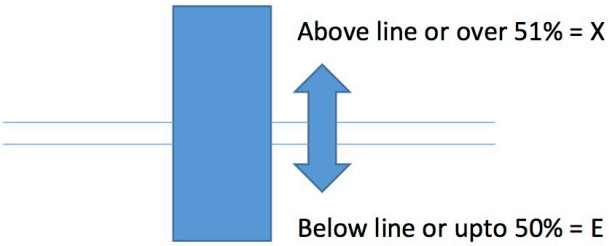
As per the job description the kitchenhand is identified as the person most likely to discard all waste from the RFSO, therefore understanding the correct method of measurement and recording of wastage outlined above is essential.

If some participants only have 1 waste stream (G) this is still to be recorded.

Bin sample standard measurements.

To be used as reference when measuring waste in wheelie bins or standard (75litre) rubbish bins.

- When bin is only half full a corresponding **H** is required to record the sample
- When bin is over half full a corresponding **X** is required to record the sample



The bins will be visually divided into 2 parts using an estimation for the half way mark.

If there is no waste the column is to be left blank.

Therefore, an example of a day's recordings may look like this:

G (Garbage)	W (Wheelie)	C (Cardboard)	O (Oils)	S (Saved)	P (Pax)
X X	**X X H**	**X**	_	**10**	**35**

This will identify:

- garbage (G) recorded 2 full bins,
- wheelie (W) recorded 2 and a half bins,
- cardboard (C) recorded 1 full bin,
- oil (O) nil was recorded,
- 10kg food was saved (S),
- and a total of 35 customers were served*.

simon.grigalius@student.bond.edu.au

2

Waste trial participation information (P1) (c)

RFSO/ Hospitality Waste data collection

To ensure privacy all participants are identified with a number/letter combination for the trial.

The forms for recording data are best left by the bin area where they are easily accessible for any person emptying the waste.

Please keep the finished forms safe for collection.

Thank-you
Simon Grigalius
Bond University

simon.grigalius@student.bond.edu.au

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Waste trial participation information (P1) (d)

RFSO/ Hospitality Waste data collection

Record table for RFSO waste stream - [ ]

Date	(G) General	(W) Wheelie	(C) Cardboard	(O) Oils	(S) Saved (kg)	(P) Pax = Customers
Sample 02/11/16	X X X H	X X	X X H	/	5	48

Markings to be used to represent bin volume:

Upto 50% of contents in bin = **H** Over 50% of contents in bin = **X**

No waste to record = **/**

Any additional staff notes:

simon.grigalius@student.bond.edu.au 4

A 5. P2 Survey

Hospitality staff – S/E Qld - 2017

This survey is for research purpose only. All information is confidential and will be obtained and stored within university ethical and security guidelines.

We ask all participants to please answer each question to the best of their ability to encourage an accurate assessment. (For privacy purposes do not add your name or business name).

1) The age group that best describes me is:
1) 16-23
2) 24-31
3) 32-39
4) 40-47
5) 48+

2) I am best described as:
1) Male
2) Female

3) I have worked in the hospitality industry for:
1) Less than a year
2) 1-5 years
3) 6-10 years
4) 11-15 years
5) 16+ years

4) I have worked in this specific business for:
1) Less than 6 months
2) 6 months – 1 year
3) 1 – 2 years
4) 2 - 5 years
5) Over 5 years

5) My position in the business is:
1) Business owner/investor
2) Manager
3) Chef/ cook
4) Waitstaff/barista, cashier/barperson
5) Apprentice chef/kitchenhand
6) Other

6) My highest education level achieved:
1) Year 10 and below
2) Year 10 and certificate 3 cookery
3) Year 12
4) Year 12 and certificate 3 cookery
5) Undergraduate degree
6) Postgraduate degree+

7) The last time I studied at a recognised training organisation (High School, TAFE, University) was:
1) 1-5 years
2) 6-11 years
3) 12+ years
4) Never

8) The last time I received formal/structured training 'on-the-job' was:
1) Up-to 1 year ago
2) 1 – 2 years ago
3) Over 2 years ago
4) Never

Thank-you for your time and honest responses.
With your help we aim to create a more balanced food system.

1

P2 Survey

Hospitality staff – S/E Qld - 2017

9) The last time I received training specific to environmental sustainability:
1) Up-to 1 year ago
2) 1 – 2 years ago
3) Over 2 years ago
4) Never

10) Out of all the global industries our current food system is the largest user of freshwater and a major contributor to greenhouse gas (GHG) emissions:
1) True
2) False
3) Unsure

11) Collectively, turning off all unnecessary electric appliances between operating times can make a difference to reducing environmental damage:
1) True
2) False
3) Unsure

12) We dispose of our trade waste in the general waste bins provided:
1) True
2) False
3) Unsure

13) Menu design can be the single most significant factor contributing to the environmental impact of any retail food business:
1) True
2) False
3) Unsure

14) A waste management plan which could include utilizing our organic waste materials (using composters/ worms farm/ animal feed) is not possible in our outlet:
1) True
2) False
3) Unsure

15) At work I have/ or have witnessed food wasted/ unnecessarily consumed:
1) All the time
2) Occasionally
3) Sometimes
4) Never

16) At work I have/ or have witnessed gas wasted/ unnecessarily consumed:
1) All the time
2) Occasionally
3) Sometimes
4) Never

17) At work I have/ or have witnessed water wasted/ unnecessarily consumed:
1) All the time
2) Occasionally
3) Sometimes
4) Never

18) At work I have/or have witnessed electricity wasted/ unnecessarily consumed:
1) All the time
2) Occasionally
3) Sometimes
4) Never

19) My RFSO uses eco-friendly take-away containers and bags:
1) All the time

Thank-you for your time and honest responses.
With your help we aim to create a more balanced food system.

2

P2 Survey

Hospitality staff – S/E Qld - 2017

2) Occasionally
3) Sometimes
4) Never

20) My RFSO re-uses materials for other uses in the outlet (eg: glass jar vases, tin cutlery holders, etc):
1) All the time
2) Occasionally
3) Sometimes
4) Never

21) At work we recycle/redirect how many separate streams of waste: (e.g.: Cardboard - Paper - Glass - Plastics - Organics – General)
1) None
2) 2
3) 3
4) 4 or more

22) The variety of different waste bins within my sector is:
1) 4
2) 3
3) 2
4) 1
5) Unsure

23) My RFSO has a vegetable or herb garden:
1) True
2) False
3) Unsure

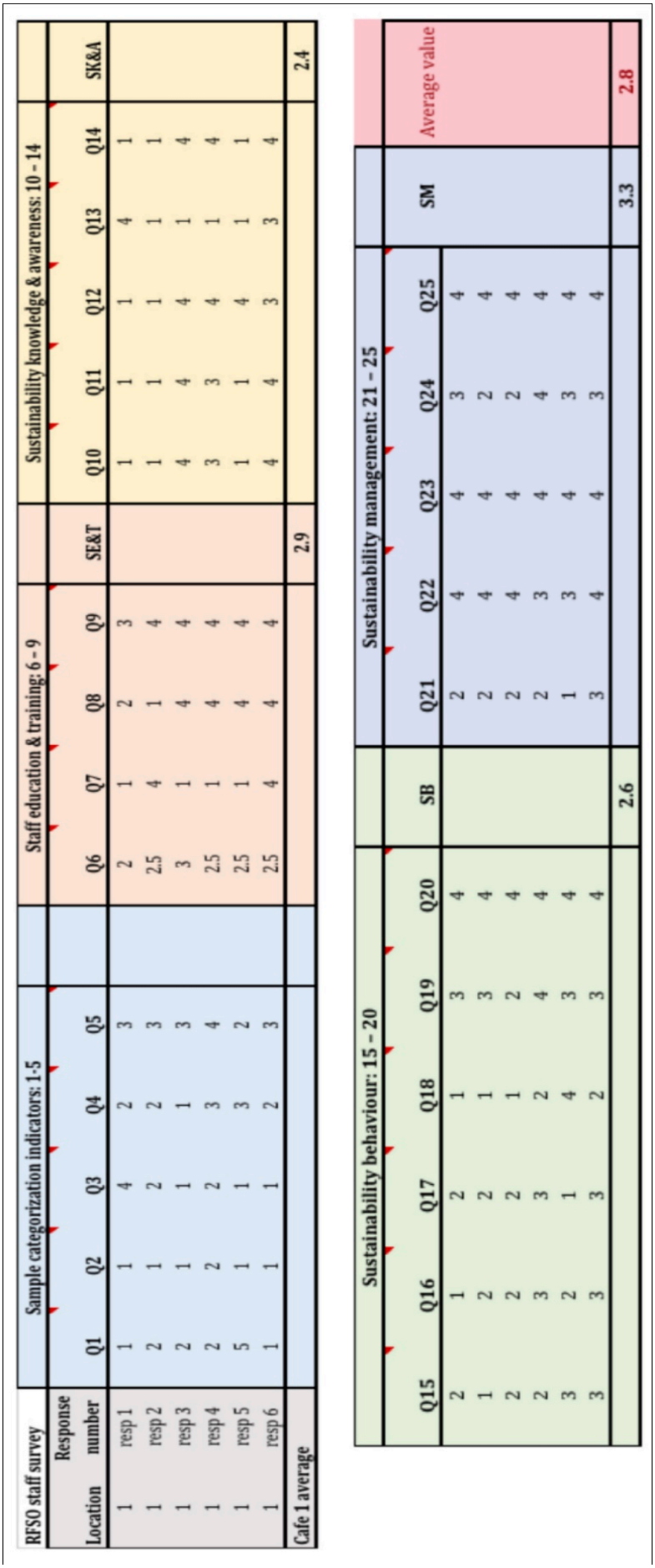
24) My RFSO allows us to take home left-over food:
1) All the time
2) Occasionally
3) Sometimes
4) Never

25) My RFSO has staff incentive programs to reduce waste and energy usage:
1) All the time
2) Occasionally
3) Sometimes
4) Never

Thank-you for your time and honest responses.
With your help we aim to create a more balanced food system.

3

A 6. Survey rating worksheet sample – RFSO One (1)

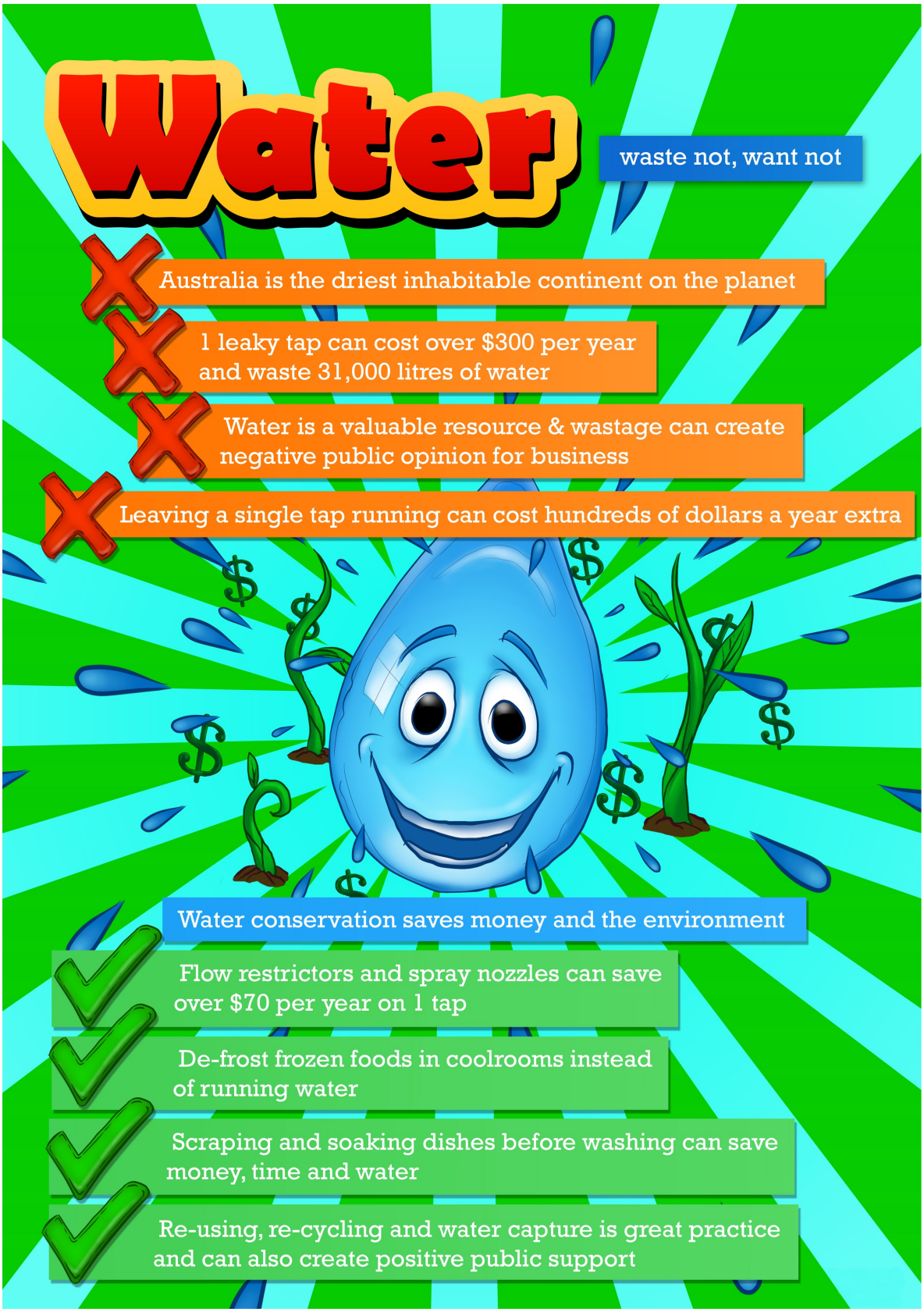


RFSO staff survey		Sample categorization indicators: 1-5						Staff education & training: 6 - 9					Sustainability knowledge & awareness: 10 - 14					
Location	Response number	Q1	Q2	Q3	Q4	Q5		Q6	Q7	Q8	Q9	SE&T	Q10	Q11	Q12	Q13	Q14	SK&A
1	resp 1	1	1	4	2	3		2	1	2	3		1	1	1	4	1	
1	resp 2	2	1	2	2	3		2.5	4	1	4		1	1	1	1	1	
1	resp 3	2	1	1	1	3		3	1	4	4		4	4	4	1	4	
1	resp 4	2	2	2	3	4		2.5	1	4	4		3	3	4	1	4	
1	resp 5	5	1	1	3	2		2.5	1	4	4		1	1	4	1	1	
1	resp 6	1	1	1	2	3		2.5	4	4	4		4	4	3	3	4	
Cafe 1 average												2.9						2.4

Sustainability behaviour: 15 – 20							Sustainability management: 21 – 25						Average value
Q15	Q16	Q17	Q18	Q19	Q20	SB	Q21	Q22	Q23	Q24	Q25	SM	
2	1	2	1	3	4		2	4	4	3	4		
1	2	2	1	3	4		2	4	4	2	4		
2	2	2	1	2	4		2	4	4	2	4		
2	3	3	2	4	4		2	3	4	4	4		
3	2	1	4	3	4		1	3	4	3	4		
3	3	3	2	3	4		3	4	4	3	4		
						2.6						3.3	2.8

A 7. RFSO Resource management banners

Water

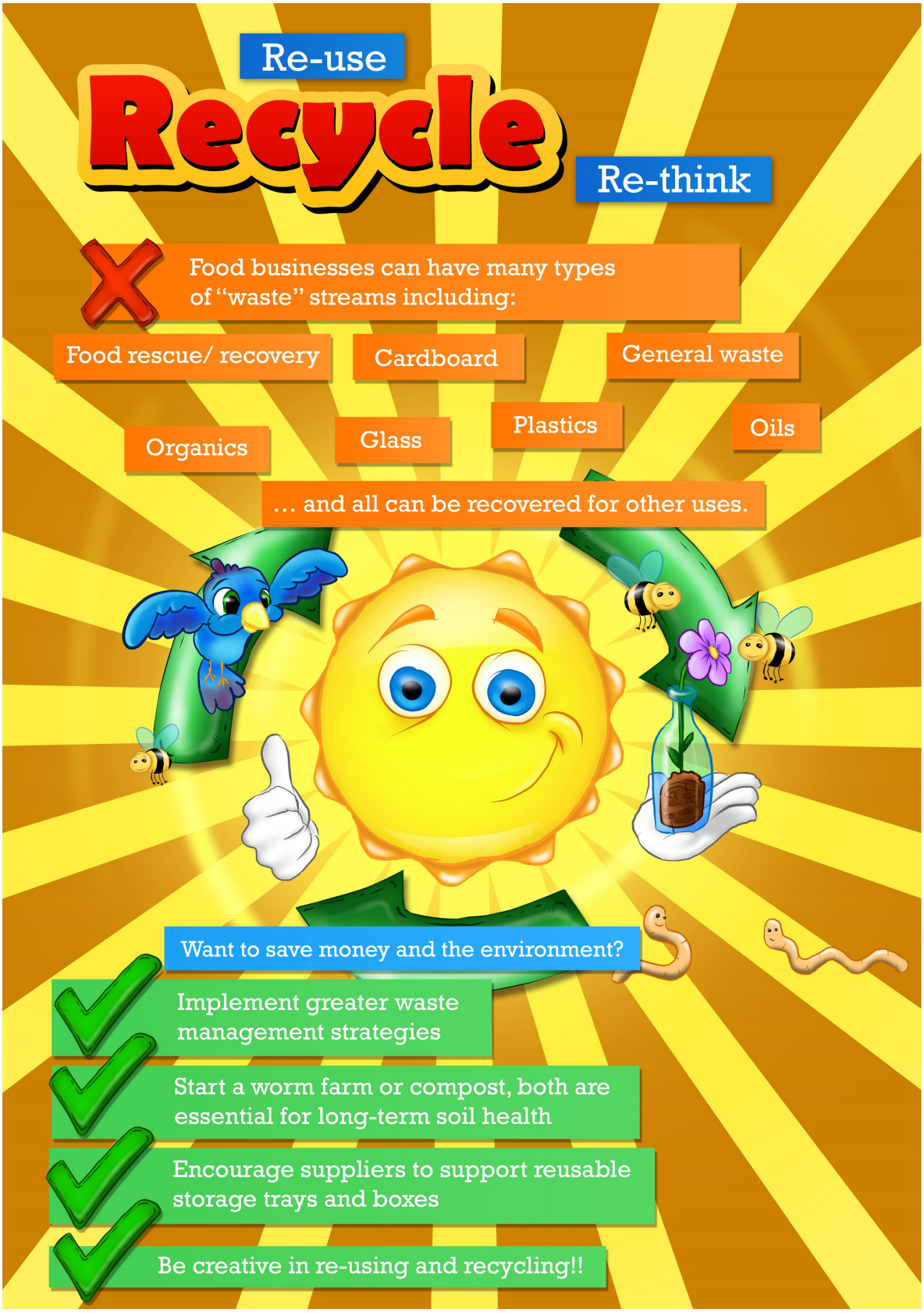


RFSO Resource management banners (Gas)

RFSO Resource management banners (Electricity)

RFSO Resource management banners (Food waste)

RFSO Resource management banners (Recycle)



A 8. Sustainability Performance Audit (a)

RFSO Audit - Sustainability Performance Score Sheet

Score 1 – 4: one (1) = best case and four (4) = worst case

1. Energy		**6. Food sustainability (Menu)**	
Self-metered energy (ammeter)		Changed: Yearly / Seasonal	
Quite/Busy power management schedule		Regional: >20, >40, <60	
Efficiency in usage:		Convenience foods: <60, >40, >20	
- Lights (separate circuits/ room dividers)		Meats: <60, >40, >20	
- Exhaust hood (Flow regulator/ age)		Imported seafood: <60, >40, >20	
- Ovens (star rating/ combi/gas)		Raw/pre-cooked: salads, etc: >20, >40, <60	
- Fryers (venue appropriate size/regular clean)		Re-use of food schedule/plan	
- Burners (Efficient burn/ flame colour/ clean)		Cooking oils (C'nut/S'flower/olive/organic)	
- Grill (Char/gas/dials)		Other	
Renewable energy %			
Heating (Insulation)		**7. Sustainability management (Back-of-house)**	
Air conditioning (split cycle/ duct)		Regular temp charts (clearly visible)	
Air curtain (entrance)		Underbench loading (air-flow & holder fridge)	
Hot water system (5-star/ solar)		Labels clearly outlining: item, date, person	
Ceiling fans		Fridge contents map outside coolroom	
Other		Resource minimization signage	
		Kitchen cleaning roster	
2. Water		Cooking schedule (Set hot times)	
Pot soaking tubs		Waste management plan	
Duel flush toilets		Waste reduction goals	
Flow control on taps		Other (sustainability training/induction)	
Spray gun			
End of service: Mop/ Hose / other		**8. Sustainability management (Front-of-house)**	
Water capture/recycling options (pasta/veg water)		Sustainability management plan	
Water use/ efficiency (Mop/hose floor)		Specialist cleaning schedule	
Other (defrost, drinking fountain)		Waste management plan	
		Waste reduction goals	
3. Chemical usage		Training/ induction (Sus Awareness prog)	
Site specific signage at sink		Eco-awards/ certification	
Automatic diluter (dishwasher)		Other (Cleaning roster: coffee mach/bar area)	
Manual addition (bottle/ squeeze pump)			
Charts and notes of chemical dilution amounts		**9. Food safety rating/score**	
Storage and signage		Food contamination	
Bio-degradable detergents		Other	
Other (Chem training)			
		10. Equipment	
4. Waste		Regular servicing schedule chart	
Management of streams: (FOH)		Under 5 years old/ star rating:	
Recyclables A (Glass, metals, etc) (BOH)		Ovens:	
Recyclables B (Plastics, cardboard/paper)(BOH)		Burners/ stove top/ hob	
Organics: pre- customer (separated)		Grill	
Organics: post customer (compost/ worm bin/ etc)		Fridges	
Variety of bins in kitchen		Dishwashers	

Sustainability Performance Audit (b)

RFSO Audit - Sustainability Performance Score Sheet

Oils (recycled)		Heat lamps	
Overall cleanliness of venue		Coolroom – (doorflaps)	
Odour (bin area/ grease trap)		Refrigeration (& seals)	
Contaminant risk (environment)		Salamander	
Waste stream signage		Other	
Grease trap (maintenance schedule)			
Other		**11. Design**	
		Coolroom position in relation to major heat	
5.Eco - awareness		Easy access to bin areas	
Menu design (Produce/ region description)		Ventilation Kitchen (Windows/doors/screens)	
Plastic v's paper (t/a cont/bags)		Ventilation store/shop/outlet	
Recycled props (Tins/crates/jars)		Natural light	
Recycled furniture		Floor (Tiles/Non-slip/ drainage)	
Herb/Vegetable garden		Sun blinds/ Window tint	
Re-usable delivery trays/cartons (food delivery)		Natural shade	
Customer education (eco-interaction)		Other	
Eco-labelling/ branding			
Other		Notes	
		Sustainability performance score	

Additional notes:

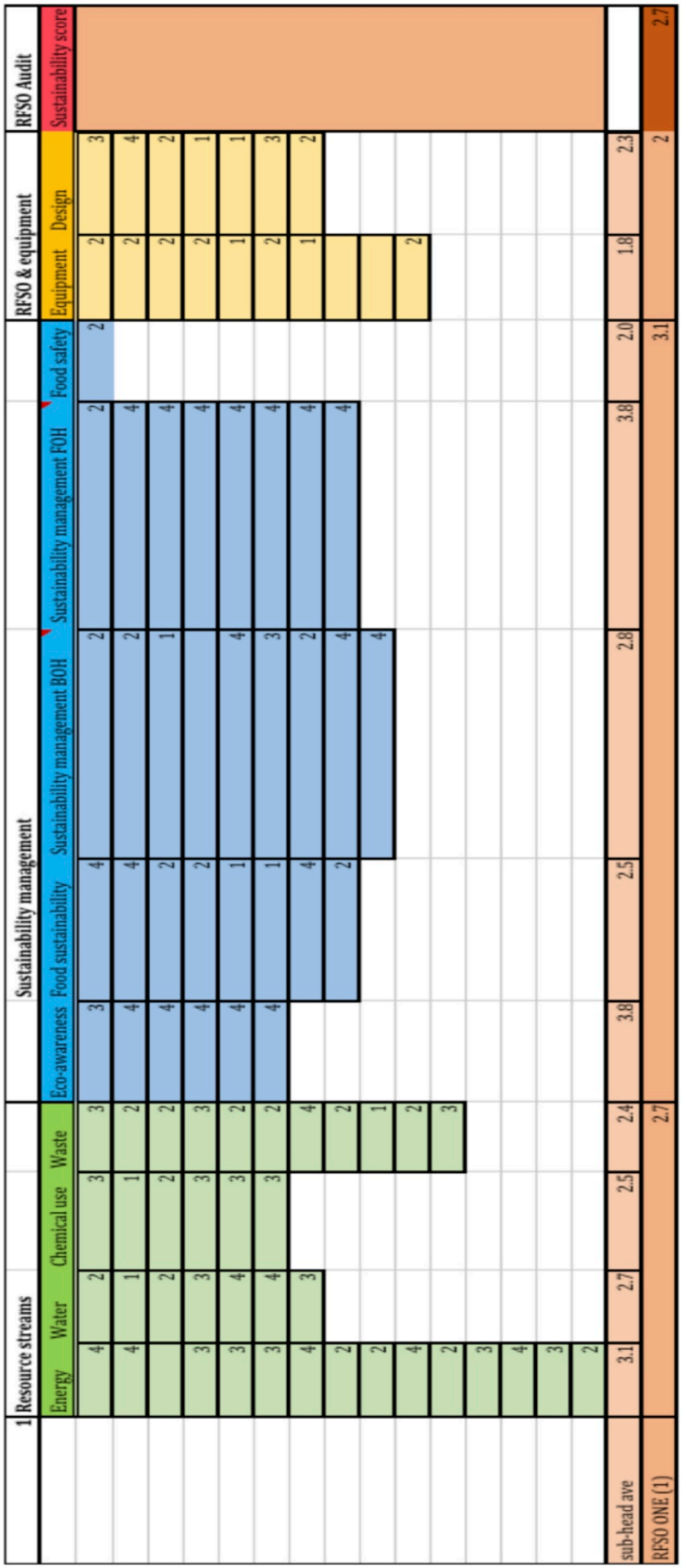
Categories:

Resource streams: 1-4

Sustainability management: 5-9

Plant & Equipment: 10-11

A 9. Sustainability Performance score – Audit sample RFSO one (1)



A 10. Additional data – P2 results

Time worked in industry & last time received formal training	up to 1 year ago	1-3 years ago	over 3 years ago	never	Row
less than a year	2 28.57%	0 0.00%	0 0.00%	5 71.43%	7
1-5 years	13 48.15%	2 7.41%	1 3.70%	11 40.74%	27
6-10 years	4 25.00%	8 50.00%	3 18.75%	1 6.25%	16
11-15 years	0 0.00%	1 12.50%	6 75.00%	1 12.50%	8
16+ years	0 0.00%	0 0.00%	9 90.00%	1 10.00%	10
All Groups	19	11	19	19	68

Food wasted & take-home left-overs	Take-home left-overs				
Food wasted	Consistently	Occasionally	Rarely	Never	Row sum
Consistently	0 0.00%	4 30.77%	9 69.23%	0 0.00%	13
Occasionally	0 0.00%	11 42.31%	12 46.15%	3 11.54%	26
Rarely	2 7.69%	7 26.92%	15 57.69%	2 7.69%	26
Never	0 0.00%	0 0.00%	1 33.33%	2 66.67%	3
All Groups	2	22	37	7	68

Time worked in industry & last time received formal training	up to 1 year ago	1-3 years ago	over 3 years ago	never
less than a year	2	0	0	5
1-5 years	13	2	1	11
6-10 years	4	8	3	1
11-15 years	0	1	6	1
16+ years	0	0	9	1
All Groups	19	11	19	19

Additional data – P2 results

Last time studied & SK&A	SK&A mean	N	SD
1-5 years	2.09	19	0.56
6-10 years	1.98	9	0.77
11+ years	2.74	13	0.42
never	2.36	27	0.87
All Groups	2.31	68	0.74